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JOHN F. KELLY, EDITOR

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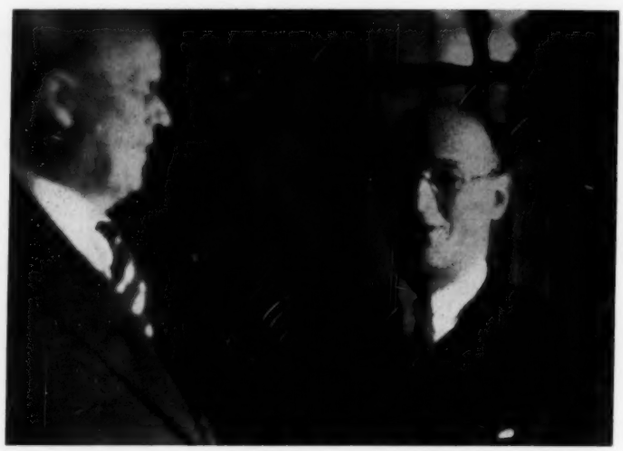
Convention and Exposition Huge Success

Measured in terms of the large attendance, caliber and number of papers presented at the technical sessions, attractive exhibits of the manufacturers servicing the steel industry, combined with the deep interest shown in all the activities, it is unanimously conceded that the 30th A. I. & S. E. E. Convention and Iron and Steel Exposition, which was held in Cleveland, Ohio, September 18, 19 and 20, was one of the most successful in the history of the society. In the following general report of the different activities sponsored by the Association, during the three days spent in Cleveland, it can readily be understood why there would be little doubt of the sweeping acceptance of the words of a prominent steel mill executive to the effect that the work of the society has contributed more to the advancement of the steel industry than that of any other group of organized men. Under such stimulus as this, the Association is determined that its justification for existence in the future shall be the same as that of the past—the fostering of all forms of engineering that steel may be made better and at a reduced cost.



I. Lamont Hughes, left, conversing with Tom M. Girdler, right, after the meeting sponsored by all the engineering divisions

Technical Sessions

Marked by the intense and prolonged discussion of the 27 papers presented by 32 authors, a total of over 2100 engineers attended the technical sessions at the Hotel Statler. Beginning with the business session on Tuesday, September 18, at 9:30 a. m., and continuing over the three day period, the electrical, mechanical, lubrication, combustion, welding and safety engineering divisions of the Association sponsored the largest as well as one of the most comprehensive technical programs so far recorded in the annals of the organization. The program was so arranged that every engineer had an opportunity to listen to a paper by an authority on a subject encompassing every engineering problem from the blast furnace down to the finishing department.

The high spot in the technical program was an address by Tom M. Girdler, Chairman of the Board and President, Republic Steel Corporation before all the engineering divisions. The huge ballroom of the Hotel Statler was filled to capacity when Mr. Girdler arose to deliver his talk on the social and industrial relations between the employer and employee after being introduced by I. Lamont Hughes, President of the Carnegie Steel Company, who presided at this meeting. In response to the many requests for Mr. Girdler's address it is being carried in full in this issue of the Iron and Steel Engineer. Also, in this current number may be found other papers and discussion presented at the sessions. Subsequent issues will contain the remaining papers and discussion.

Inspection Trip

On Wednesday afternoon, at the invitation of Mr.

Tom M. Girdler, flanked by the past presidents and board of directors of the A. I. & S. E. E., addressing the members.

Part of the vast throng who gathered to hear Mr. Girdler.

General view of first aisle of the Iron and Steel Exposition.

E. J. Kulas, President of the Otis Steel Company, 475 members of the Association visited the Riverside works of that company. The inspection party was conveyed from the Hotel Statler to the plant by fifteen specially chartered buses. After arriving at the plant, the members had the option of first visiting the eight 150 ton open hearths or proceeding directly to the soaking pit building. Those who chose the latter were taken to inspect the 40" blooming mill, the motor room for the 72" hot strip mill, and the 72" hot strip mill where strip in plate and sheet gauges, up to 66" wide, is rolled. After completing the inspection of the hot strip mill, the guests were met by the buses and taken over to the 72" cold mill to watch the strip being cold rolled into auto body gauges up to 66" wide. Following the inspection of the cold mill, the entire party was conveyed to the Cleveland Public Auditorium to view the iron and steel exposition.

Iron and Steel Exposition

Justifying their confidence in the steel industry as a market for the sales of their products and with the view of contacting the men who in the last five years have been responsible for the purchase of over five-hundred million dollars worth of equipment, 84 manufacturers utilized 30,000 square feet of space to display their standard and latest developments at the iron and steel exposition held under the auspices of the A. I. & S. E. E. at the Cleveland Public Auditorium, September 18, 19 and 20. Using the one-way method of travel, which necessitated passing every booth, the 8,000 visitors to the exposition were impressed by the diversity of products and colorfully decorated booths. From the general views illustrated on this page of this issue, it can readily be seen the pains taken by the exhibitor to create an effective display. Traveling up and down the various aisles

General view of second aisle of Iron and Steel Exposition.

could be seen anti-friction bearings of the largest and smallest sizes, the latest developments in welding machines, every conceivable type of electrical and mechanical equipment, miniature working models of cranes and ingot strippers, material handling equipment for every purpose in the steel plant which included the latest designs in industrial trucks, lubricants and centralized systems of lubrication and striking displays of equipment for metallurgical furnaces. While from the standpoint of the number of square feet of spaces used this was not the largest iron and steel exposition ever held, it proved to be of such mutual good both to the steel mill engineers and exhibitors that its continuance is unquestioned.

Convention and Iron and Steel Exposition Statistics

Number of steel plants represented	119
Number of industrial plants represented	159
Representatives from steel plants	6,156
Representatives from industrial plants	4,206
Total attendance	10,362
Number of positions or occupations in attendance	430
Number of states in attendance	22
Number of cities in attendance	187
Steel producing tons represented in attendance	58,429,000
Total horsepower represented in attendance	5,500,000
Total attendance at technical sessions	2,178
Total attendance at inspection trip	475
Approximate number of miles traveled by guests and members	585,000

List of Manufacturers Who Exhibited at the Iron and Steel Exposition

▲

Ajax Flexible Coupling Co.
Ajax Wyatt Co.
Alliance Machine Co.
Allis-Chalmers Mfg. Co.
Aluminum Co. of America
American Air Filter Co., Inc.
Amsler-Morton Co.
Automatic Transportation Co.
Bailey Meter Co.
Baker-Raulang Co.
Bartlett-Hayward Co.
Benjamin Electric Mfg. Co.
H. A. Brassert & Co.
Brown Instrument Co.
Bull Dog Electric Products Co.
Bussmann Manufacturing Co.
Chase-Shawmut Co.
Chicago Rawhide Mfg. Co.
Clark Controller Co.
Cleveland Crane & Engr. Co.
Cleveland Electric Illuminating Co.
Colt's Patent Fire Arms Mfg. Co.
Continental Roll & Steel Fdry. Co.
Crocker-Wheeler Electric Mfg. Co.
Crouse-Hinds Co.
Cutler-Hammer, Inc.
Dodd Company
Edison Storage Battery Co.
Electric Controller & Mfg. Co.
Electric Storage Battery Co.
Electrical Housekeeping, Inc.
Electrical League of Cleveland
Elwell Parker Electric Co.
Enterprise Electric Lighting Fixture Co.
Erie Steel Construction Co.
Farval Corporation
Fenn College
Fulton Foundry & Machine Co.
General Electric Co.
General Electric Supply Corp.
Great Western Fuse Co.
E. F. Hauserman Co.
Albert M. Higley Co.
Hodson Associates
Hodson Corporation
Holophane Co., Inc.
Homestead Valve Mfg. Co.
Hyatt Roller Bearing Co.
Ideal Commutator Dresser Co.
Iron & Steel Engineer—A. I. & S. E. E.
I-T-E Circuit Breaker Company
Ivanhoe Division of Miller & Co.
Johns-Manville
C. M. Kemp Manufacturing Co.
Keystone Lubricating Co.
Leeds & Northrup Co.
Lubrication Products Co.
Lukens Steel Co. (Lukenweld Division)
Martien Electric Co.
Martindale Electric Co.
Mercury Manufacturing Company
Minneapolis-Honeywell Regulator Co.
Morgan Engineering Co.
Morganite Brush Co., Inc.
National Carbon Co., Inc.
National-Erie Corporation
National Safety Council
North American Mfg. Co.
Norma-Hoffmann Bearings Corp.
Ohio Bell Telephone Co.
Ohio Carbon Co.
Ohio Desk Co.
Ohio Electric Mfg. Co.
Optical Lighting Institute
Pyle-National Co.
Reliance Electric & Engr. Co.
Rollway Bearing Co., Inc.
S-K-F Industries, Inc.
Smith-Obey
Standard Oil Co. (Ohio)
Steel-Penton Publishing Co.
Strong, Carlisle & Hammond Co.
Superior Carbon Products, Inc.
Thompson Electric Co.
Timken Roller Bearing Co.
Tool Steel Gear & Pinion Co.
Trabon Lubricating Equipment Co.
Trumbull Electric Mfg. Co.
United-American Bosch Corp.
United Engineering & Foundry Co.
Wagner Electric Corporation
Westinghouse Electric & Mfg. Co.
Westinghouse Electric Supply Co.
Weston Electrical Instrument Corp.
Yale & Towne Mfg. Co.

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Social and Industrial Relations Between The Employer and The Employee

By TOM M. GIRDLER,
Chairman of the Board and President,
Republic Steel Corporation

In this time of disturbed labor conditions, when the Country is torn with strife that ought not to exist, when business is halting with apprehension of the future, I desire to make an earnest plea for better relations between employers and employees. I am speaking from the standpoint of general industry and not merely of my own company.

One of the important reasons that is checking the recovery of general business is the unsettled condition of labor, and this condition is so unnecessary, so uncalled for, considering the present status of labor and all that the Government is doing in its behalf, that it is well worth our while to give this subject careful consideration.

I draw a sharp distinction between labor, meaning the man on the job, the man earning a living for himself and his family, and those who seek to exploit labor.

I have a deep and sincere sympathy for the workers. I know what it means to earn bread by the sweat of the brow. Even now, while I fully appreciate the privilege of being the chief executive of a large steel company, I am sure you will sympathize with me when I say there are times when I envy the man with the dinner pail who has no responsibility other than to do the day's work right and draw the day's pay. The burdens and the perplexities which are imposed daily upon the management of a steel company requiring the solution of innumerable business, financial, labor, governmental and other questions, tax the strength of all of us to the utmost.

Many writers whose knowledge of labor conditions is most superficial, express the view that operating men are not sympathetic with efforts to improve them. They do not take into consideration the terrific burden resting upon the executives and staff men of every large company to find business to keep their plants—or some of them—running, to operate at a manufacturing cost that will permit the company to exist in a fiercely competitive market, and to meet and absorb the ever-increasing cost burdens imposed by governmental taxes and regulations.

Our duty to Labor is to try to give the largest opportunity for employment, the highest wages and the best working conditions that our business will consistently afford. In fact, all of you who have examined the profit and loss record of the Steel Industry thus far this year, know that we have been paying wages higher than the industry can afford. We have done our best to give Labor a square deal. Please do not confuse this term with the so-called New Deal. These terms are not necessarily synonymous.

BEFORE an estimated audience of over 1,000 members of the A. I. & S. E. E., Tom M. Girdler, chairman of the board and president, Republic Steel Corp., made the feature address of the 30th convention and iron and steel exposition at the Hotel Statler, Tuesday, September 18. Following an introduction by I. Lamont Hughes, president, Carnegie Steel Company, who presided at the meeting, Mr. Girdler minced few words in stressing the advantages of the employee representation plan of collective bargaining as contrasted to the destructive practices of professional labor unions.

Until the millenium comes, it is not likely that Labor will ever feel it is receiving its full due, or that employers will cease to feel the burden of the cost of labor. It is inevitable that there will always be a certain amount of difficulty in adjusting these conflicting points of view.

I have a very definite opinion based on many years of experience as to the best and in fact the only practical method of dealing with this subject.

Direct contact between the management and employee, without the intervention of any outsider, affords the only workable plan. The reason for this is that the outsider always has some other motive than the welfare of the employees or the employer and this is almost always a selfish one.

In a small business, the executive can keep very close to such controversies. In a large business made up of many plants, such matters must in the first instance be delegated. Since the management acts through its representatives, labor is likewise entitled to be represented. But the representatives of both sides should be chosen from the staff and workers of the plant itself.

In my opinion, the employee representation plan which is now in operation in the Steel Industry and in many other industries is the natural development of the personal contact which the manager of a single plant has with his men, and affords this direct contact in a way which cannot be obtained through any other method that has been presented.

I cannot take the time here to describe this plan in detail and most of you are familiar with it anyway. The employees choose by a secret ballot at an election conducted entirely by themselves, representatives who act on committees with representatives of the management to hear and determine complaints. An aggrieved employee who cannot obtain redress from his foreman, may take up his case with the committee and if not satisfied with their decision may carry his appeal to the President of the company and even to the Secretary of Labor.

This plan is founded upon the premise that employees and employers have mutual interests, best served by the maintenance of harmony, confidence and understanding between employer and employees, under a collective bargaining plan which works for the benefit of both.

Employees are represented by men they know personally, who are thoroughly familiar with local conditions and know from experience what they are talking about.

The employee representation plan provides for

day to day action. Issues which arise may be discussed and settled immediately.

This plan gives free play to individual ability, encourages the use of the incentive system, and offers employees opportunities for advancement based upon efficiency, intelligence and capacity for leadership. Most of the executives in the Steel Industry today have reached their high positions entirely through opportunities afforded in this way.

If you have any doubt as to how the employee representation plan works, I wish you could attend one of the meetings between employee representatives and management representatives.

Our men know what they want. They are not afraid to ask for it. If it is possible to get, they get it. If it is something they are not entitled to, I assure you we have to present facts and figures to show them clearly why we cannot afford to give it to them. Sometimes, when we start to explain, we find out that we were wrong and that they were right.

TOM M. GIRDLER

Since the employee representation plan was put into operation at Republic Steel Corporation, 1978 questions of one kind or another have been raised, discussed and settled under this plan and the great majority of them were settled in accordance with the request of the employees or were amicably compromised.

I think that the employee representation plan presents collective bargaining in the truest sense of the term and is making and will continue to make for better relations between employer and employee.

As time goes on, the employees' representatives become more familiar with Company affairs. They begin to get some insight into the difficulties of management, including the problems of production, sales and earnings. They begin to understand that before money can be paid out, money must come in. So they learn, after a while, what is a reasonable thing to ask for and what is unreasonable. The management in the same way learns what is reasonable and what is unreasonable.

There finally develops a kind of working agreement or understanding, a sort of partnership between men and management, that would be absolutely impossible under the theory of perpetual conflict which apparently animates the action of the American Federation of Labor.

The mere statement of the Employee Representation Plan shows the contrast with the well known practice of professional labor leaders, and I might add that the Employee Representation Plan is not a recent development. It was in effect in many large companies many years before the N. R. A. was adopted.

The professional labor leaders, greedy for power and for the payment of dues into the treasury of their organization, seem to think the N. R. A. was passed for their particular private benefit and they seek to give the impression that the strong arm of the government will actually force control into their hands even in respect of an industry in which the majority of the workers do not want them and are entirely satisfied with their own form of collective bargaining.

Why is it, for instance, that the very provisions of N. R. A., which were designed to bring about peace in industrial relationships, have been major factors in bringing about continual conflict? Why is it that there should be strikes and bloodshed in great industries operating under codes, where questions of wages, hours and working conditions are largely regulated by the Government through these codes? The answer is plain. The officers of the American Federation of Labor see or think they see an opportunity to impose Union regulations on industries where they have no standing. If successful, would the Union add to the income of the workers? On the contrary, the Union would take from them vast sums in the form of dues for which they never make any public accounting.

Apparently the officers of the Unions can spend these vast sums of money without being responsible to anyone.

Is it conceivable that the business agents of labor unions, who care nothing about plant conditions, can be as well qualified to discuss grievances as representatives chosen by the men themselves from their own number? I think not.

The business agent of the Union does not come to promote peace. He and his Union thrive through promoting discord. The more dissatisfaction he can create, the greater the chance of securing new recruits for the Union and the more dues for its treasury. The Union continually seeks and always has sought, to create a spirit of hostility and strife between employees and employers, where otherwise peace and harmony would prevail.

I know that the leaders of the American Federation of Labor would strenuously deny these statements, but there is a vast difference between what Union Labor leaders promise and what they perform.

I have been astounded and often amused by Union accounts of what happened as compared with what actually happened.

This reminds me of the very old story of the two telephone linemen who were working on a pole outside the second story window of a residence. The lady who owned this home was startled and shocked by a tremendous clatter, and a wild burst of profanity and the sounds of a fight. She called up the Superintendent of the telephone company and complained. He said that he would investigate immediately. He called the men into his office and asked them what had happened. One man said, "Boss, I was working on the ground at the foot of the pole in front of 226 Bank Street. Bill was up on the pole soldering a broken cable. He tilted his ladle and dropped some molten lead down the back of my neck. I immediately looked up and said, "Bill I think you will have to be more careful".

I have often said in the strongest language I can use that agreements with Union labor leaders cannot be relied upon. You need not, however, depend upon my word alone. We have recently had conspicuous illustration of the truth of this charge.

General Hugh S. Johnson, head of the N. R. A., has recently declared that the leaders of the textile union called that great strike in violation of an express agreement and understanding reached with him, that no strike should be called, and he has publicly condemned in words that cannot be misunderstood the action of the labor leaders in thus breaking faith.

I cannot vouch for the facts, but this incident is certainly in line with my many years of experience with labor leaders. As a result, we have 400,000 employees of textile mills on strike, when they might have been working. Rioting has occurred and lives have been lost in bloody conflicts in more than one state, and if you analyze the controversy between the parties, you will find that the underlying and practically the only question at issue is the effort of the textile union to secure recognition.

While I condemn the motives and action of these labor leaders, I do not overlook their sagacity. They have seen the golden opportunity for ordering strikes. No burden is imposed upon their organization to provide relief for the thousands of families thrown out of work. The strikers who go off the payroll of the mills can be and are promptly placed upon the relief rolls of the Administration, thereby encouraging great industrial conflicts which would not otherwise exist and which ought never to have been precipitated.

I do not question the right of the worker to join any organization he chooses. But, on the other hand, I deny the right, morally or legally, of the organization to which he does not belong, to attempt by force, intimidation or otherwise, to compel him to submit to its will, and I intend to continue to stand as I have in the past, firmly against the aggression of such labor leaders.

There ought to be statutes in the United States specifically making it illegal to intimidate any worker by force and violence, such as is practiced by strikers. In England they have already taken a forward step in this direction as a result of their bitter experience in the General Strike of 1925. I am not qualified to discuss legal matters, but I want to bring to your attention a provision embodied in the British Trade Disputes and Trade Unions Act of 1927, making it illegal and criminal to intimidate workers. That provision is as follows:

(1) It is hereby declared that it is unlawful for one or more persons (whether acting on their behalf or on behalf of a trade union or of an individual employer or firm, and notwithstanding that they may be acting in contemplation or furtherance of a trade dispute) to attend at or near a house or place where a person resides or works or carries on business or happens to be, for the purpose of obtaining or communicating information or of persuading or inducing any person to work or abstain from working, if they so attend in such numbers or otherwise in such manner as to be calculated to intimidate any person in that house or place, or to obstruct the approach thereto or egress there from, or to lead to a breach of the peace; and attending at or near any house or place in such numbers or in such manner as is by this subsection declared to be unlawful, shall be deemed to be a watching or besetting of that house or place within the meaning of Section 7 of the Conspiracy, and Protection of Property Act, 1875.

(2) In this section the expression "to intimidate" means to cause in the mind of a person a reasonable apprehension of injury to him or to any member of his family or to any of his dependents or of violence or damage to any person or property, and the expression "injury" includes injury to a person in respect of his business, occupation, employment or other source of income, and includes any actionable wrong.

When Congress provided for collective bargaining, I do not believe it intended to say that a bare majority of workers could prevent the minority from selecting their own representatives to deal with the management. Such an interpretation of collective bargaining would deprive the worker of freedom of action, instead of giving him greater liberty, and would subject him to the will of agents whom he did not choose and in whom he has no confidence.

I am advised by my counsel and believe that such ruling is an incorrect interpretation of the law. It is simply a further attempt to impose the closed shop on industry.

This is not merely a controversy between the two conflicting viewpoints as to the handling of labor. It is a question which affects fundamentally the welfare and prosperity of all industry and that means the Nation as a whole.

What is the situation in Industry today? After a brief period of prosperity, there has come a collapse almost as serious as that existing in April, 1933. Unless we can have a general recovery of business this fall, the coming winter will present relief problems which will dwarf all that has gone before. According to the statistics given out through the public press, the number of families receiving relief in the City of

Cleveland reached an all-time peak in the month of August. What will happen next January and February, especially if we have another such winter as the last one, if the furnaces and steel mills and manufacturing institutions of this great industrial district do not return to something like a normal state of employment? It is not a situation pleasant to contemplate. In my opinion one of the fundamental causes for the halting of business is the uncertainty prevailing with reference to the unsettled and turbulent labor situation throughout the country.

I am by nature an optimist. I have a profound belief in the ultimate prosperity of the iron and steel industry which is practically the foundation of all industry, but nevertheless, I tell you in all seriousness that I view with the deepest apprehension the immediate outlook in the business world.

Now, by way of conclusion,—it seems to have become popular to say that constitutional rights no longer exist and that we have outgrown the institutions set up by our forefathers.

I regard all such statements as sheer nonsense. I am old-fashioned. I believe in the value of the American institutions. The development of this country has been made possible by the constitution under which we live. I believe it is the duty of every citizen to defend that Constitution and I certainly intend, so far as I am able, to resist all efforts to tear it down.

STEEL EMPLOYMENT LOWER AS OPERATIONS DECLINE

▲

Although steel mill output declined 14 per cent in August compared with July, employment was only 5 per cent less than July and total payrolls were less than 2 per cent under the preceding month, according to the American Iron and Steel Institute. The average number of hours worked per man increased during August, as did average earnings per hour, the report shows.

The number of wage earners employed in August was 364,583, as compared with 383,673 in July. Wages, exclusive of salaried employees, totaled $25,691,520 in August, against $26,150,272 in July.

Average hours worked per week by wage earners increased from 24.4 in July to 25 in August. Average earnings per hour in August increased to 63.5 cents, only slightly less than the all-time record of 64.8 cents per hour established in April, 1934.

The steel industry had a total employment in August of 404,793 compared with 424,126 in July. The total payroll for the month was $34,362,208, only 2 per cent lower than the July payroll of $34,913,521.

The following table shows wages and employment in August, 1934, July, 1934, and June, 1933, the latter the first month of operation under the steel code:

	August, 1934	July, 1934	June, 1933
All employees	404,793	424,126	338,146
Wage earners	364,583	383,673	305,239
Wages	$25,691,520	$26,150,272	$24,441,054
Hours per week	25.0	24.4	39.4
Average earnings per hour	63.5c	63.2c	47.3c
Operating rate	22.93	26.75	45.37

A. I. & S. E. E. MEMBERS ACTIVE AT NATIONAL SAFETY CONGRESS

▲

Following the precedents established in 1912 when the National Safety Council was formed under the auspices of the A. I. & S. E. E., many prominent members of the society and executives of the Republic Steel Corporation took part in the National Safety Congress held recently in Cleveland, Ohio.

J. A. Voss, director of industrial relations of the Republic Steel Corporation, was elected chairman of the important Metals Section of the Safety Council. This is the oldest and one of the largest divisions in the organization.

J. D. Donovan, superintendent of maintenance, Central Alloy District, Republic Steel Corporation, talked on "Safety Maintenance on Industrial Electrical Equipment." He said in part:

"Five cardinal points must be considered for safe maintenance work on industrial electrical equipment.

"Effective accident prevention work when handling industrial electrical equipment depends on (1) good and approved equipment; (2) proper installations; (3) correct safeguarding; (4) good repair tools and equipment; (5) high type of men; (6) proper safety education.

"It is the general opinion of safety engineers today that all electrical apparatus be enclosed so that only authorized persons can possibly come into contact with current carrying parts. No open wiring is permitted. The electrical engineer in the steel mill has a difficult problem because every piece of electrical apparatus that is installed must be done in a manner that will permit ready removal in case of trouble."

F. W. Cramer, Superintendent of Electrical Construction, Youngstown District, Republic Steel Corporation, discussed maintenance of cranes; a complete copy of the paper being published on page 411 of this issue.

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JOHN F. KELLY, Editor.
Sworn to and subscribed before me this 2nd day of October, 1934.
HENRY W. BALDWIN, Notary Public.
(My commission expires April 16, 1937)

The Progress of Centralized Lubrication In The Steel Industry

By A. J. JENNINGS
The Farval Corporation, Cleveland, Ohio

Paper presented at the 30th A. I. & S. E. E. Convention held in Cleveland, Ohio, September 18, 19 and 20, 1934.

When centralized lubrication was first introduced, the steel industry was primarily concerned with maintaining maximum production and any operation, or item of equipment, responsible for delays or loss of tonnage, was given immediate attention.

Under these conditions, centralized lubrication in some plants was used for all roll neck bearings and in others its use was limited to the plain bearing stands only. Some considered cranes of major importance, while others gave first consideration to their table roll bearings. On the other hand, in many plants it was felt that furnace pushers—shears—straighteners—levellers, etc., required better lubrication to eliminate these delays.

From these early installations, which were made in different plants all over the country, the use of centralized lubrication has been extended to include nearly all types of mill equipment, and many plants now use some form of lubricating equipment throughout the entire mill.

This broad application to all types of mills has not alone provided a very substantial reduction in the cost of lubrication per ton of steel, but has clearly demonstrated the economy of centralized lubrication on all of the major items of mill equipment.

The problem in the steel industry today is to obtain even lower costs, in the face of greatly reduced operations, and the use of any materials, or equipment, that will provide a lower cost per ton of steel produced, must be given serious consideration.

Centralized lubrication will provide an economy in every department of the mill and lower operating costs as well as increased tonnages can be obtained in every plant, by means of better lubrication.

In this paper we shall endeavor to present, in the limited time available, some of the actual results of the use of centralized lubrication on many different types of mills and mill equipment. These facts clearly show how centralized lubrication has reduced costs and we hope they may prove valuable to the operating departments.

Proper lubrication not alone requires the use of the correct grade of lubricant, but also that this lubricant be properly applied by a dependable method and at regular intervals.

We all know that the hit-and-miss method of hand lubrication is not reliable and that it usually results in either a feast or a famine for all bearings—with some being missed entirely.

It is not surprising, therefore, that frequent repairs—wasted lubricant—increased friction and lost production always follow.

A modern centralized system of lubrication will prevent these losses by providing the positive delivery of a measured charge of lubricant, to a group of bearings from one central point, entirely independent of the judgment of the oiler or his ability to reach all bearings regularly.

A. J. JENNINGS

Some of the economies resulting from the use of centralized lubrication on the many items of mill equipment are as follows:

Reduced Power Consumption, from 5 to 30%.
Increased Life of Bearings, from 400 to 1000%.
Reduced Consumption of Lubricant, from 25 to 50%.
Reduced Consumption of Water.
Reduced Labor of Oiling, 90%.
Reduced Maintenance and Repairs.
Prolonged Life of the Equipment.
Provided Complete Safety.
Reduced Fire Hazard.
Eliminated Spoilage of Materials from Excess Lubricant.
Increased Production
—by reducing rejections due to off-gauge rolling.
—by eliminating the need for frequent mill adjustment.
—by permitting a faster and hotter rolling of steel.
—by giving a more free-running mill and thus making the additional power available for handling heavier drafts.

Time and space will not permit recording the economies obtained, on all of the different items of mill equipment to which centralized lubrication has

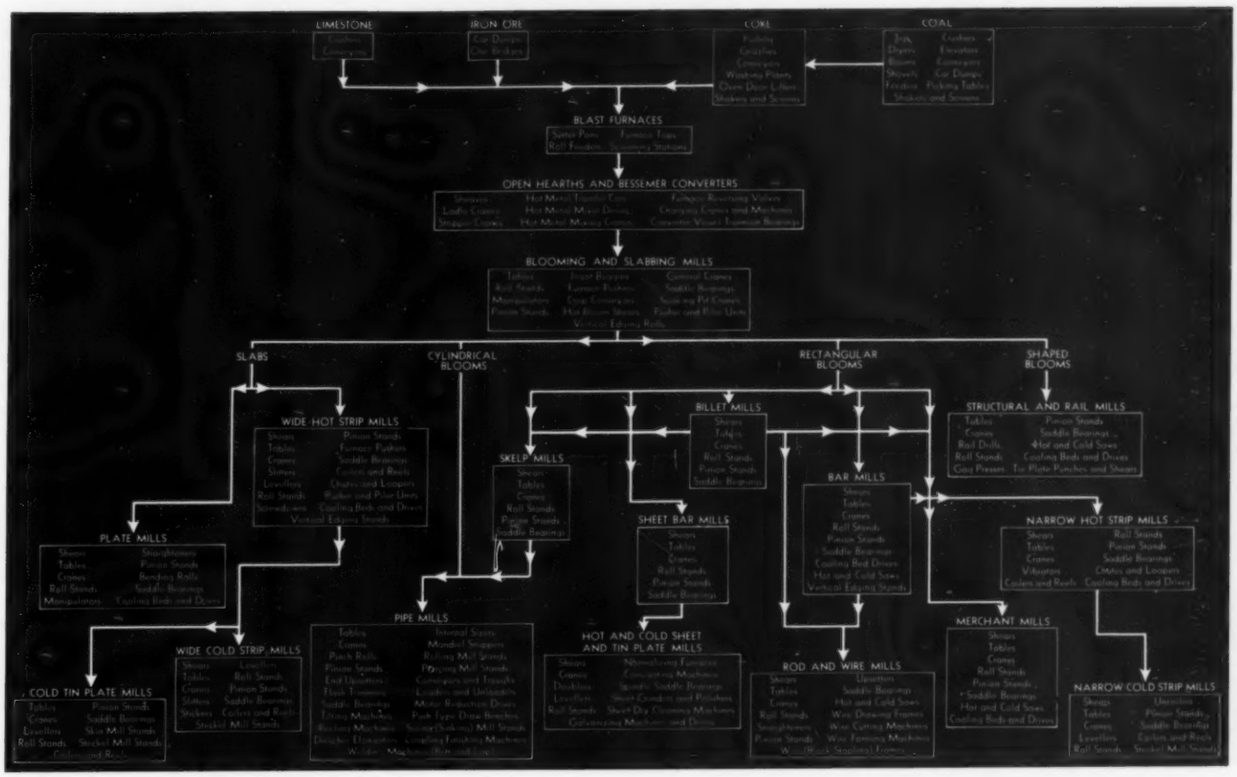

FIG. 1

been applied. We have therefore prepared a flow sheet, Fig. 1, covering the principal items of equipment in the different mills, showing where centralized lubrication is being used to provide a lower operating cost.

Blooming and Slabbing Mills

The savings in power and increased bearing life will pay for the installation of a centralized system on the average bloomer, plate mill or slabbing mill, in approximately three months' operation.

The lubricating system injects the grease under high pressure, between the bearing surfaces in exact quantities and at regular, frequent intervals, sufficient to maintain a proper film of lubricant at all times. The reduced friction at the necks on some installations has reduced the power consumption by as much as 15%. This gain in power is available to handle heavier drafts and to thus increase daily tonnages.

Consumption of lubricant is also materially reduced, because all waste is eliminated and there is no excess grease to fall down into the pit when making roll changes.

Fig. 2 shows a centralized lubricating system applied to a 35" blooming mill. You will note the lubricating valves have been mounted on the end of the housing with a flexible hose to connect to the bearing inlets.

We have prepared a chart, Fig. 3, to show the results obtained with centralized lubrication as compared to hand packed necks, on a blooming mill. The comparison is not based upon the maximum economy of centralized lubrication on one mill, as against the highest cost resulting from hand packed necks on another mill. These figures represent the average costs obtained from several different mills, where lubrication has been given careful attention.

In the first section of this chart you will note we have outlined the range of costs with hand lubrication which naturally vary between the limits shown depending upon the tonnage rolled per month, the care and attention given to lubrication, and the cost per kilowatt hour for power in the different mills.

In the second section of the chart we have outlined the average cost with hand lubrication and good practice rolling, using an average cost for the three items instead of the highest or the lowest. We also show the cost for these items when using cen-

FIG. 2

BLOOMING MILLS

General Costs with Hand Lubrication

Electric Power Cost per Ton	$.07 to .12
Bearing and Labor Cost Per Ton	$.006 to .018
Lubricant (Roll Necks Only) Cost per Ton	$.003 to .03

Production—30,000 to 90,000 tons per month.

AVERAGE COSTS WITH GOOD PRACTICE ROLLING

Hand Lubrication per Ton		Centralized Lubrication per Ton		Savings per Ton
Power	$.09	Power (Less 10%)	$.0810	$.0090
Bearings	$.009	Bearings (Less 85%)	$.0013	$.0078
Lubricant	$.008	Lubricant (Less 10%)	$.0073	$.0008
Total	$.107	Total	$.0895	$.0176 per ton

Cost for:		Cost for:	Monthly Savings
90,000 Tons	$9630.00	90,000 Tons—$8055.00	$1575.00
60,000 Tons	$6420.00	60,000 Tons—$5370.00	$1050.00
40,000 Tons	$4280.00	40,000 Tons—$3580.00	$ 700.00

AVERAGE INSTALLED COST OF CENTRALIZED LUBRICATION—$1800.00

YEARLY RETURN ON INVESTMENT:

Tons per Month	Yearly Saving	Yearly Return
90,000	$18,900.00	1050%
60,000	$12,600.00	700%
40,000	$ 8,400.00	466%

FIG. 3

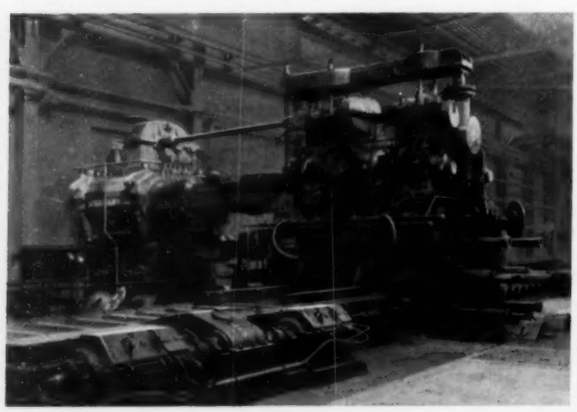

FIG. 4

tralized lubrication and these figures are also based upon the average results from several mills and not upon the best results on one individual installation.

The total savings amount to $.0176 per ton as an average of several installations. On some installations the savings have been greater and, of course, on other installations the savings have been less depending upon such factors as the cost per kilowatt hour for power, monthly tonnages, etc.

In the next column of figures we have translated the costs and the savings in dollars and cents. The average cost for the complete installation of a centralized system is approximately $1800.00 and in the last column of figures you will note we have prepared a comparison to show the yearly savings and the percentage of return on the investment.

It will be noted that the average yearly return on the investment is approximately 700%. Any investment that will pay a 50% yearly return usually is given serious consideration and in view of this fact, these figures on the economy of centralized lubrication should be of special interest when the need for lower operating costs is paramount.

Fig. 4 shows a centralized system as applied to a universal plate mill and on this particular installation 92 points of lubrication are served by the automatic system. The other bearings on this mill are cared for by two manually-operated systems.

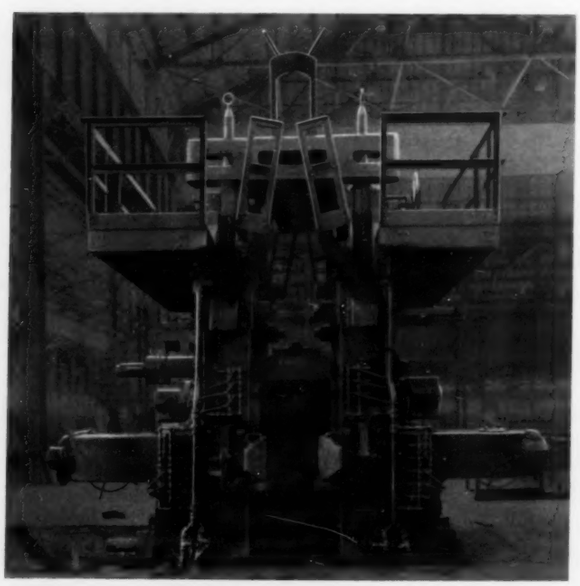

FIG. 5

SHEET BAR AND MERCHANT MILLS

General Costs with Hand Lubrication

Electric Power Cost per Ton	$.12 to .25
Bearing and Labor Cost per Ton	$.025 to .06
Lubricant (Roll Necks Only) Cost per Ton	$.008 to .025

Production—12,000 to 30,000 tons per month.

AVERAGE COSTS WITH GOOD PRACTICE ROLLING

Hand Lubrication per Ton		Centralized Lubrication Per Ton		Savings per Ton
Power	$.15	Power (Less 20%)	$.12	$.03
Bearings	$.03	Bearings (Less 90%)	$.003	$.027
Lubricant	$.01	Lubricant (Less 10%)	$.009	$.001
Total	$.19	Total	$.132	$.058 per ton

Cost for:		Cost for:	Monthly Savings
15,000 Tons	$2850.00	15,000 Tons—$1980.00	$ 870.00
20,000 Tons	$3800.00	20,000 Tons—$2640.00	$1160.00
30,000 Tons	$5700.00	30,000 Tons—$3960.00	$1740.00

AVERAGE INSTALLED COST OF CENTRALIZED LUBRICATION—$3000.00

YEARLY RETURN ON INVESTMENT:

Tons per Month	Yearly Saving	Yearly Return
15,000	$10,440.00	348%
20,000	$13,920.00	464%
30,000	$20,880.00	696%

FIG. 6

On one installation on a universal plate mill, where vertical edging roll bearings are subject to severe service, it was found, at the end of two years' operation, that these bearings did not require replacement and that even the thrust collars were in excellent condition.

Structural and Rail Mills

Fig. 5 shows a spare finishing stand for a beam mill. Note that the spare stand is complete equipped with lubricating valves, and ready to be placed into the mill train, where the lubricating equipment can then be connected to the main grease supply lines.

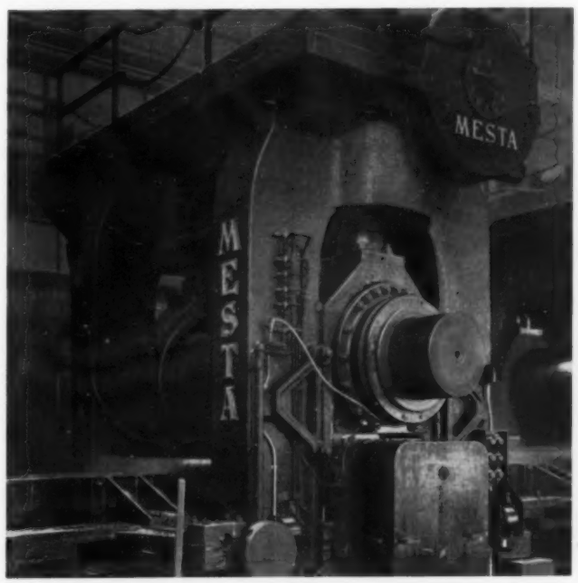

FIG. 7

On structural and rail mills, as well as on billet and bar mills, centralized lubrication, which delivers the grease directly to the thrust collars, has greatly increased the life of these bearings. On some installations the bearing life has been increased by more than 600%.

By getting proper lubrication on the finishing stands of these mills, they have been able to hold the sections more accurately, and definitely increased production by increasing good practice rolling.

On an 18" sheet bar mill, centralized lubrication has practically eliminated all rejections due to off-gauge rolling, and this item alone has paid for the cost of the installation many times. Additional economies resulting from the use of centralized lubrication on this mill are as follows:

Reduced Power Consumption 30%.
Increased Life of Bearings 1200%.
Increased the Tonnage per Bearing Change from a former average of 12,000 tons to more than 150,000 tons.

The lubricating system was also applied to the pinion neck bearings of this mill and increased the life of these bearings by more than 1000%.

We have also prepared a chart, Fig. 6, to show the results obtained with centralized lubrication as compared to hand packed necks on sheet bar and merchant mills. This chart is also based upon the average cost for hand lubrication and for centralized lubrication with good practice rolling and is not based upon one individual installation in either case.

The first section of this chart shows the general

range of costs with hand lubrication which vary with the cost for power, tonnage rolled, etc.

You will note that the average net saving per ton on this type of mill is $.058, providing a monthly saving between $870.00 and $1740.00, depending upon the monthly tonnage.

The cost for a complete installation of a centralized system of lubrication will average approximately $3000.00, and the yearly return on the investment will vary from 348% to approximately 700% depending on the tonnage per month.

The figures given above are for motor driven mills and in general the cost of power for steam driven mills is usually from two to three times that of the motor driven equipment. The savings, therefore, would be proportionately greater on a steam engine driven mill.

Hot and Cold Strip Mills

Fig. 7 illustrates one of the stands of a 4-Hi continuous strip mill, and here the mounting of the grease lubricating valves is clearly shown on the

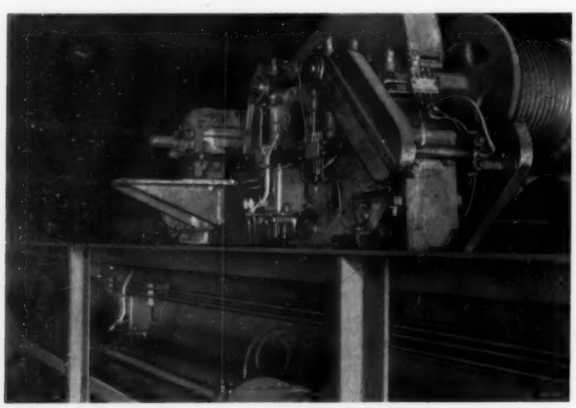

FIG. 8

mill housing together with the discharge lines leading to the roll neck bearings, which are of the anti-friction roller type.

On the anti-friction type of roll neck bearing, and particularly on the 4-Hi mills, centralized lubrication is rapidly approaching a point where its use is becoming universal for this service.

Centralized lubrication provides protection against repair and replacement for these expensive roller bearings and from this standpoint alone, it is generally recognized as essential to their continuous operation. By its use the grease is kept at the proper level in these bearings, and water and scale are kept out, because the proper amount of grease maintains the full efficiency of the bearing seals.

Table Roll Bearings

On table roll bearings, centralized lubrication will reduce power consumption, speed up the rolls, increase bearing life, and practically eliminate all labor of oiling. On a blooming mill table installation, power consumption was reduced 25% and bearing life was increased 600%.

While most mills do not keep a separate power record of each item of motor-driven equipment, we

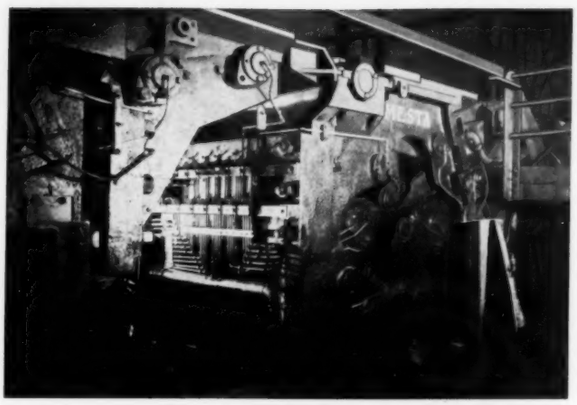

FIG. 9

desire to point out that 1 hp. per year costs the average mill a minimum $28.00. This figure is based on operating six days per week, with a power cost of ½c per kilowatt hour.

Proper lubrication for any bearing will reduce friction and lower the consumption of power. Therefore, the savings in power to be obtained from the use of centralized lubrication on such items of equipment as manipulators, tables, cranes, shears, etc., should receive the serious consideration of every operating executive.

Two 150 hp. motors are used to drive the tables mentioned, and a 25% saving amounts to 75 hp. per year or a minimum of approximately $1575.000, with these motors operating 75% of the time.

Cranes

Fig. 8 shows a manually operated centralized lubricating system as applied to an overhead crane. You will note one pumping unit is mounted on the trolley to serve all bearings and a second pumping unit is mounted on the bridge serving the bearings on the drive shaft and the truck wheels.

One of the outstanding advantages of centralized lubrication on overhead traveling cranes is the safety it provides for one of the dangerous jobs in the mill.

In addition, it reduces the labor of oiling at least 90%. In one plant ten men were given 30 minutes to lubricate one large ladle crane, and found it was actually impossible for them to cover all of the bearings by hand, in this period of time. With a centralized system of lubrication, one man can lubricate all of the bearings on such a crane in less than 5 minutes and with entire safety.

Because of the time saved in greasing cranes with centralized lubrication, users have also found that a competent man can give his undivided attention to making a better and a more complete inspection of all parts of the crane.

In sheet mills the problem of drippage is reduced to a minimum because an accurate control over the amount delivered to each bearing, leaves no excess to drop onto the stock below.

On roller bearing equipped cranes, centralized lubrication insures the delivery of clean grease, protects the investment in this type of bearing, and prevents over-lubrication.

Coilers

On Fig. 9 is shown two hot strip coilers equipped with centralized lubricating systems which serve a total of 174 points of lubrication on these two coilers.

The lubrication of hot strip coilers is a difficult and an important operation, because it is next to impossible to lubricate them by hand while they are operating, and any serious trouble at the coilers holds up the entire mill.

Lack of lubrication means frozen bearings and sticking coils and lost production. Centralized lubrication on two coilers provided a reduction in power of 25% and entirely eliminated all lost production from sticking coils. On two other hot strip coilers, with centralized lubrication, all bearings were found to be in perfect condition at the end of more than two years of continuous service.

Shears, Punches, Straighteners and Levellers

On Fig. 10 a full automatic system of lubrication is used to supply the frequent delivery of lubricant to all bearings on this 500-ton billet shear.

We hardly feel it is necessary to point out the need for centralized lubrication on hot bloom shears and billet shears, which must give continuous and trouble-free performance under difficult conditions of service. In fact the best results can only be obtained, through the use of a full automatic system of lubrication, which will provide the frequent delivery of a heavy bodied lubricant. Punches must also meet the requirements of heavy duty service and should be lubricated by a similar method.

Many straighteners have a large number of bearings that must be given positive and dependable lubrication at regular intervals, and some of these bearings are inaccessible and difficult to lubricate by hand. Under these conditions, centralized lubrication can perform a real service and will quickly justify the expense of its installation.

The sheet roller leveller illustrated on Fig. 11 is equipped with a full automatic system of lubrication, but the delivery of lubricant to the backing roll bearings is controlled by a separate hand valve. By this method all drive bearings receive automatic lubrication at regular intervals, with the backing rolls receiving lubrication only when the hand control valve is operated. This prevents delivery of excess lubricant to the backing rolls eliminating the drippage of any lubricant on to the sheets.

FIG. 10

Proper lubrication of sheet roller leveller bearings will maintain continuous production and insure accurate performance at all times. Centralized lubrication will also prevent the delivery of excess lubricant to the backing roll bearings and eliminate the hazard of lubricant getting onto the sheets. This is accomplished by using a separate hand valve to control the delivery of lubricant to the backing roll bearings only.

Blast Furnace Tops

From the standpoint of safety alone, all bearings on blast furnace tops should be equipped with a centralized system of lubrication. Men need not be exposed to the danger of blast furnace gases when complete lubrication can be provided by one man from a safe, convenient, central point, located on the stove platform. Also, because all bearings may be lubricated as frequently as desired, regardless of the condition of the top, the savings in maintenance will fully pay for the cost of the installation in a very few months.

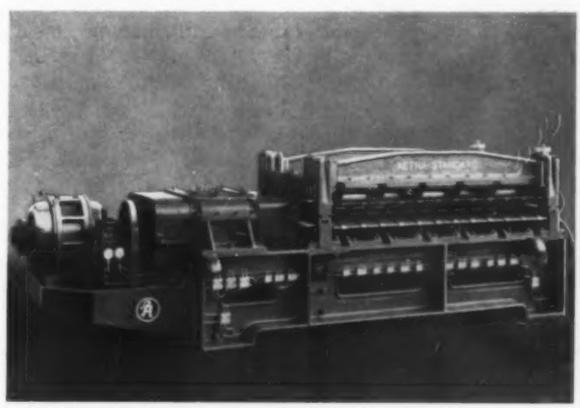

FIG. 11

New Equipment

While the economies we have outlined are the result of the use of centralized lubrication on existing equipment its use on new equipment is of equal, if not of greater, importance. As a matter of fact, during the past several years many plants have included a specification to provide a modern centralized system of lubrication on all new equipment purchased.

Full production and freedom from repairs on new equipment will continue only so long as all bearings receive proper lubrication at regular intervals. A dependable system of lubrication will insure proper performance of new equipment, protect it in advance against costly shut-downs, and reduce the expense

of repair and maintenance. In addition, only a short increase in the total life of the equipment will fully justify the added investment.

Grooving of Bearings

These illustrations of bearing grooves are not intended as a specific recommendation but merely illustrate types of grooves which have been used successfully.

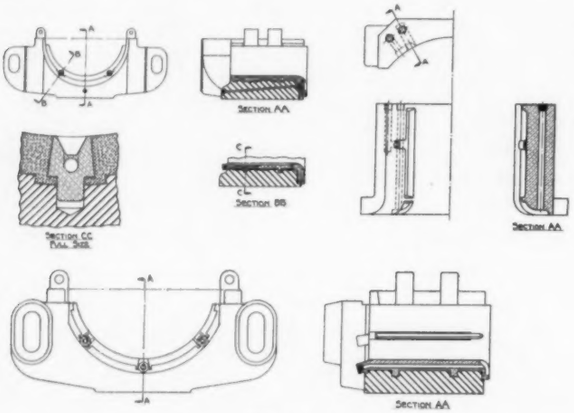

FIG. 12

Fig. 12 illustrates two methods of grooving bearings on a reversing type of mill and one method for grooving a non-reversing type of mill. In both illustrations a separate lead is used to deliver grease to the thrust collar independent of the radial surfaces.

By one method brass grids are laid into the bearing shell to provide the proper width and depth of groove, and the babbitt is poured in around these grids. One method is to use one of these grids to reach the thrust surface, this grid having no opening into the radial surface. The other method is to drill through the bearing chuck with a suitable hole opening directly into the thrust surface. On the reversing type of mill both methods include two grooves for the radial surface to provide proper distribution on the neck regardless of which way the roll is turning.

The bearing grooves for the non-reversing mill are also provided as shown at the right by means of bronze grids. In this case, however, only one groove is required for the radial surface.

Fig. 13 illustrates various methods of grooving the smaller types of bearings. The upper left view shows a bearing having a very small thrust surface and illustrates one groove leading to both the radial and thrust areas. In the left center section the bearing shown represents the type of grooving which has proven successful for center roll bearings of 3-Hi mills and you will note that there is a separate lead for the radial surface and a separate lead for the thrust surface.

The lower left drawing shows another method of using two leads into the bearing, both of which are at one side of the bearing. Similar grooves and holes are also located on the other side of this bearing to permit its use on either side of the mill. Note the taper on the groove to provide a radius and eliminating all sharp edges.

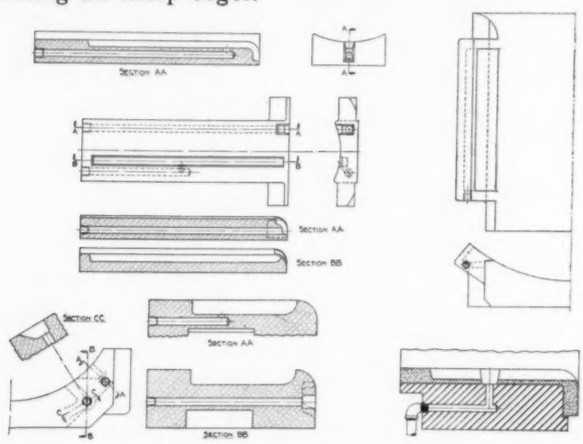

FIG. 13

The other method shows the bearing groove carried partially into the thrust with the bearing chuck cut away to accommodate the connection where the coupling box is very close to the end of the bearing.

Another method is shown wherein an extension has been added to the casting forming a pocket at the side with the proper shape in the groove. This method can be used where the bearing loads are high and the space required for grooves cannot be spared.

Centralized Lubricating Systems

As the use of centralized lubrication has been extended to include more and more mill equipment, manufacturers of lubricating systems have also kept progress by continually improving and perfecting their product to meet the different conditions of mill service. We are therefore giving a brief description, with suitable illustrations, outlining the construction and principles of operation of most of the leading centralized systems of lubrication used in the steel industry.

Bosch Lubricator

The Bosch forced-feed grease lubricator, which is manufactured by the United American Bosch Corporation of Springfield Massachusetts, is illustrated on Fig. A. The cylindrical tank serves as a container for the grease and the lower section houses the entire pumping system with its driving worm wheel.

The pumping system consists of a multiple of pump units each one of which furnished the supply of grease required by the individual bearing. The effective stroke of the pumping unit is adjustable to thus vary the amount discharged into the outlets, and a suitable tube or pipe is run from each outlet to the bearing or point of lubrication.

On Fig. B is shown the scoop and helical disc feeder in the tank for pressing the grease into the pumping unit to insure proper priming. These pumping units are arranged centrally around the pump shaft and the two cam discs mounted on this shaft

FIG. A

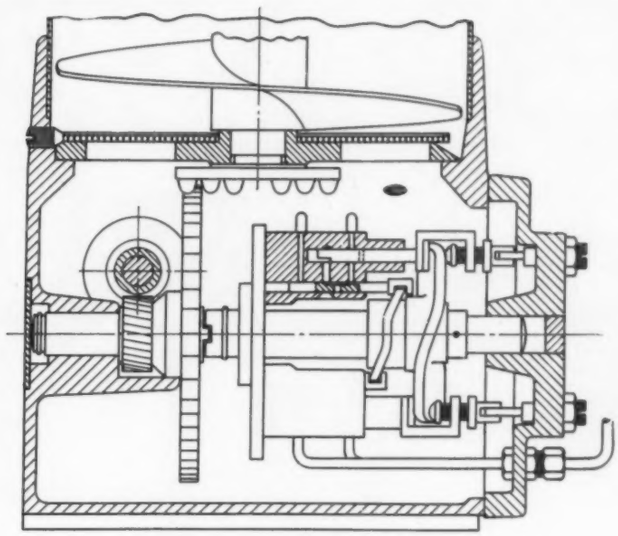

FIG. B

actuate the pump plungers and the grease guide plungers. The effective stroke of the pump plungers being controlled by the adjusting screws at the right.

The lubricator is usually operated from the equipment it serves and may be driven from either a rotating or reciprocating member.

Gordon System

The Gordon System which is manufactured by R. M. Gordon & Company of Pittsburgh, Pennsylvania, employs the principle of a displacement valve to control the amount of lubricant delivered to the bearing.

The Gordon valve which is adjustable and indicating is illustrated on Fig. C. All valves are supplied with grease under constant pressure from one main supply line. A mechanically operated slide valve in each valve is used to direct the flow of lubricant to either end of the main measuring chamber. As lubricant enters on one side of the main piston, a measured quantity is discharged from the opposite side through one of the valve outlets. A group of measuring valves and the valve tripper arrangement are shown on Fig. D. The motor driven valve tripper which is connected to a group of valves by the operating bar and levers, is electrically timed to provide the operation of all valves at any desired interval.

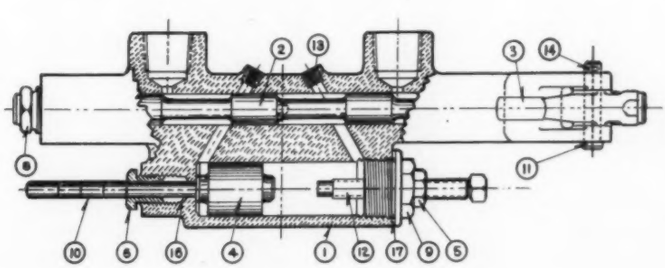

FIG. C

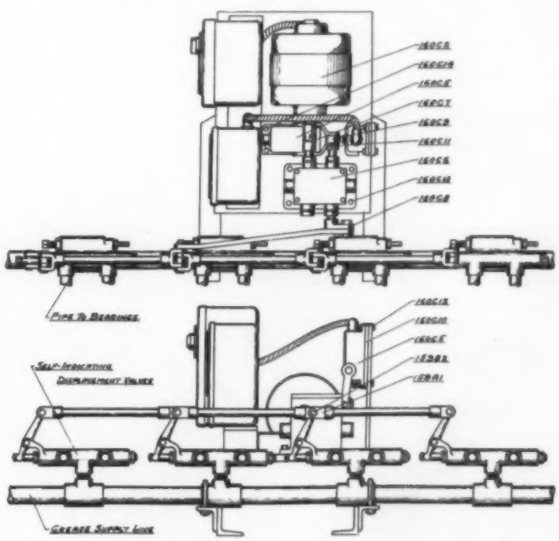

FIG. D

Adams-Schuette System

The Adams-Schuette System which is manufactured by The Hodson Corporation of Chicago, Ill., uses an air operated piston displacement valve to control the amount of lubricant delivered to each bearing, as illustrated on Fig. F.

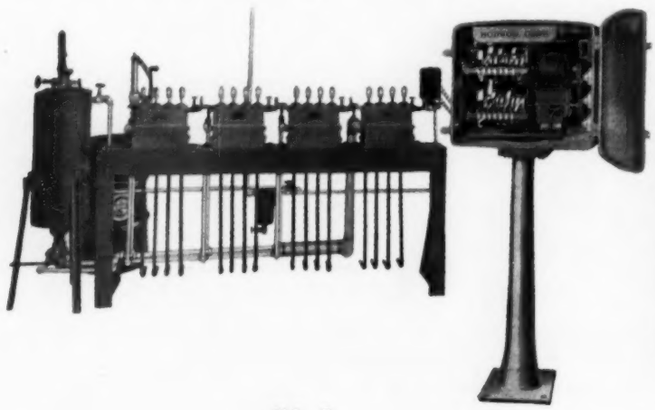

FIG. E

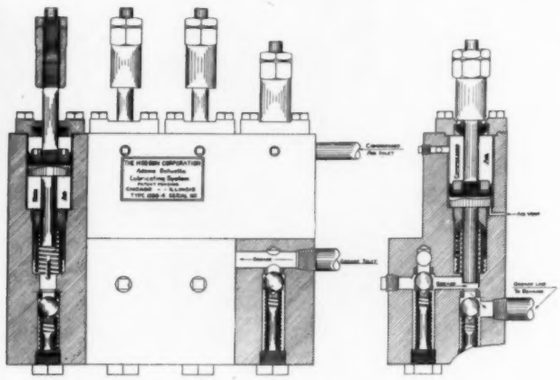

FIG F

Each group of valves is supplied with grease under constant pressure from one main supply line. In the sectional view at the left, Fig F, the measuring chamber (directly below the small plunger) has been filled with grease. In the sectional view at the right, air pressure on the larger piston at the top has discharged the measured quantity of grease from the lower chamber, through the valve outlet.

When the air pressure is released in the top chamber, the valve plungers are returned to their original position by the lubricant under pressure from the valve inlet which again fills the lower measuring chamber. Each valve is adjustable and indicating.

The system is operated each time that air pressure is applied and the timing arrangement is shown on Fig. E. Lubricant under constant pressure in the main grease tank is the source of supply for all valves. Delivery of compressed air to discharge a group of valves is controlled by a solenoid air valve and this solenoid is electrically timed to provide the desired interval of operation.

Fig. E shows a complete system including the electric timer, grease supply tank and the measuring valves from which suitable pipes lead to the bearings.

Trabon System

The Trabon System which is manufactured by the Lubricating Equipment Company of Cleveland, O., uses a progressive type of piston displacement feeder to control the amount of lubricant delivered to each bearing, as illustrated on Fig. G.

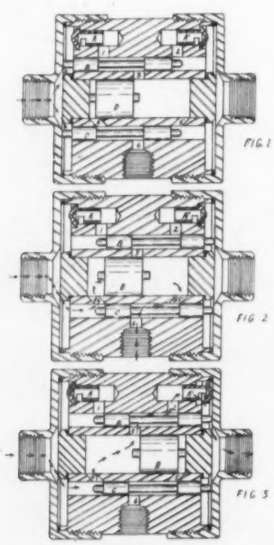

FIG. G

FIG. H

All feeders are installed in a complete loop or circuit which leads back to the source of lubricant supply and each feeder must operate before the lubricant can pass through it, to operate the next feeder. When lubricant pressure reaches the feeder shown in the top view, the resistance plug "A" is moved to its seat and the dumb-bell pistons are moved

to the position shown in the center view. Lubricant entering the main measuring chamber moves the large piston to discharge a measured amount from the opposite side, through the feeder outlet.

When the large piston reaches the end of its stroke as shown in the lower view, the lubricant will pass through this feeder and on to the next one as illustrated.

At the next operation of the system the flow of lubricant through the main circuit is reversed, to provide operation of all feeders in the opposite direction. An electric timer controls the starting of the motor driven grease pump and pressure at the return end of the system circuit shuts it off.

The central grease pumping unit which is used to supply lubricant under pressure for the entire system is shown on Fig. H.

Anderson Pump

The Anderson (Mill Type) grease pump which is manufactured by the Hills-McCanna Company of Chicago, Illinois, is illustrated on Fig. I.

In this unit the amount of lubricant displaced with each stroke of the pump, controls the amount delivered to the bearings. The effective stroke of the pump being adjustable to provide a wide variation in the amount delivered.

The Anderson displacement pump is provided with a positive mechanical valve action that prevents slippage and insures full efficiency at any pressure up to 5000 lbs. per square inch.

Lubricant is delivered to the mill bearings by means of the distributor head through suitable discharge lines. The distributor is indexed to one discharge line on the intake stroke of the pump plunger and remains fixed during the discharge stroke, after which it indexes to the next feed and continues in rotation.

The unit is usually connected to an individual motor, but practically any type of drive may be employed if desired.

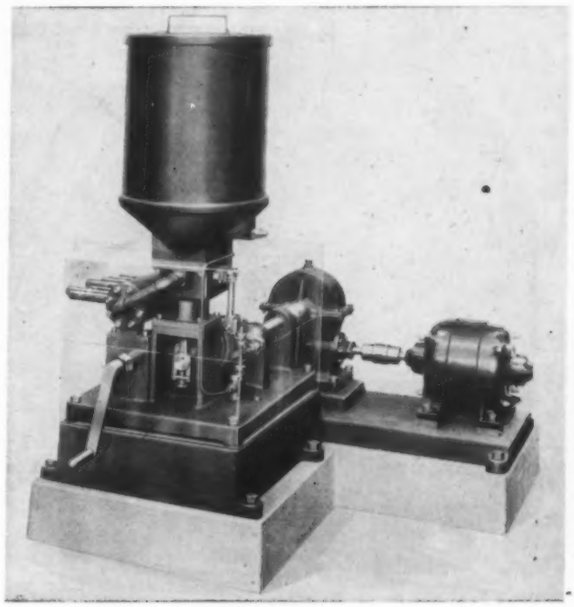

FIG. I

Farval System

The Farval Dualine System which is manufactured by The Farval Corporation of Cleveland, O., uses a piston displacement measuring valve to control the delivery of lubricant to each bearing as illustrated on Fig. J.

Each valve is adjustable and self indicating and operates independently of the other valves in the system. Two main supply lines leading from one central pumping unit are used to connect to all valves in the system. When pressure is applied to one supply line the hydraulic slide valve in each Farval valve directs the flow of lubricant to one end of the

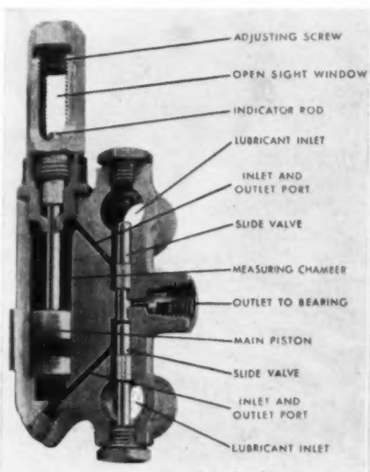

FIG. J

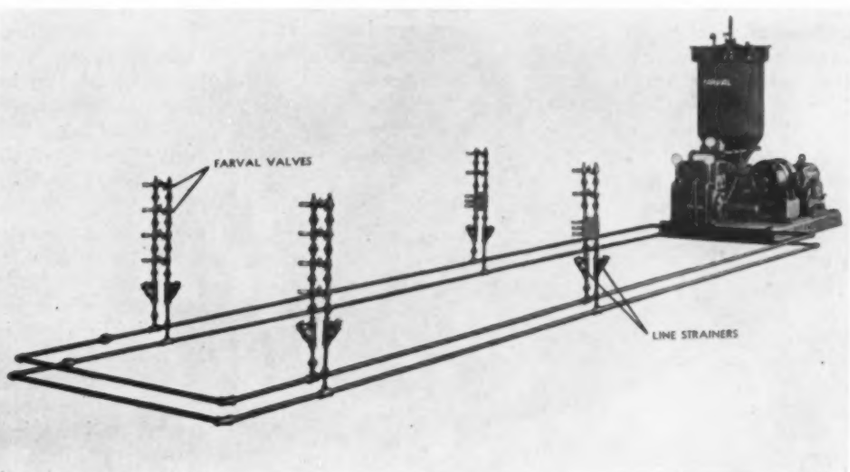

FIG. K

main measuring chamber, moving the main piston to discharge a measured quantity of lubricant through the valve outlet. When pressure is applied to the other supply line the movement of the valve pistons is reversed to discharge a measured quantity of grease from all valves, through the movement of the main piston in the opposite direction.

The complete system which is installed in a loop or circuit as illustrated on Fig. K. This system is hydraulically timed to control the frequency of operation and may be adjusted to obtain any desired time interval.

Electrical Equipment For High Speed Precision Merchant Mills

By R. H. WRIGHT,
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Paper presented before A. I. & S. E. E. at its Annual Convention held in Cleveland, Ohio, September 18, 19, 20, 1934.

During the past few years, steel mill engineers have observed with great interest the rapid development in the methods of manufacturing a number of steel products. Latest methods of rolling strip, sheet, tinplate and certain types of structural shapes are typical examples of this rapid evolution in rolling mill practice. In most cases, changes have been made in the product as well as in the rolling practice. Old mill equipment has been discarded and replaced with new equipment embodying revolutionary ideas in mill design. Probably the most noticeable feature of the new equipment is the provision for extremely accurate control of the section at all points in the rolling process. Rolling schedules are carefully worked out and rigidly adhered to.

Meanwhile, a more gradual change in methods of rolling merchant mill products has been taking place. Fundamentally, the rolling of merchant bar sections is still an art rather than an exact science. Because of the wide variety of sections rolled and the frequency of roll changes, mill equipment has been very simple as compared with present equipment for many other products. The skill and experience of the roller therefore plays an important part in the successful performance of the mill. Different rollers often prefer to use different rolling schedules when rolling the same section on the same mill. It is not unusual for a roller when starting in on his turn to rearrange the mill drafts before proceeding to finish an order on which the preceding turn crew had been rolling satisfactorily.

The gradual evolution of merchant mill design, beginning with the single stand slow speed hand mill has resulted in the development of the Belgian mill, cross country mill, semi-continuous mill and continuous high speed mill. Existing installations include all of these types. A considerable number of mills are 15 to 20 years old and changing demand has made many of them obsolete except for a limited range of product. More recent installations are designed to roll a wider range of product at speeds ranging up to 2100 feet per minute. With this array of equipment, steel makers are now confronted with the problem of meeting the demand for much closer tolerances on many sections and at the same time securing unit outputs which will make the operation profitable.

FIG. 1—Verticle edging stands with 800 H.P. vertical motors.

Mills installed recently have been either continuous type or semi-continuous type. At present it appears that as older mills are to be replaced, the tendency will be to use more of these two types of mills. Fewer mills will be required because of the greater output per mill.

From the very beginning of the electrification of rolling mills, the requirements of merchant mills have taxed the ingenuity of the electrical engineer. The electrical engineer's first problem in laying out a new mill is that of determining the capacity, speed range and operating characteristics of the main drive motors. This problem usually is complicated by the difficulty of obtaining the exact reductions to be made in each stand. In a mill where each motor is to drive several stands this may not affect the final result seriously. With a continuous mill having a separate motor on each stand, an accurate knowledge of reductions which can and will be used is required in determining the proper motor speeds and horsepower ratings. The speed range of the motors is especially important. Horsepower ratings can be selected to include a margin for all contingencies but unless the proper speed ranges are selected, the mill performance is distinctly limited.

Determination of rolling schedules requires close co-operation between the engineers, the roll designer and the roller. Naturally, every merchant mill which has been built was laid out with certain work and certain rolling schedules in mind. Since different

rollers use different rolling practice, the schedules as laid out are usually not followed. Variations in analysis of steel and changing market demand also make it necessary to have some latitude in rolling practice. It may seem impracticable to the average roller to roll merchant bar in accordance with predetermined schedules of drafts and speeds as is done, for example, on certain types of beam mills, or as is done with rod mills rolling only a few sizes of product. However, it does seem possible to work much closer to uniform schedules than is now usually done. It also seems that as mill speeds increase and tolerances grow smaller some such procedure will be necessary.

Rollers and roll designers undoubtedly have an excellent practical knowledge of plastic flow of hot metal under a wide range of conditions. By coordinating this information with mill load data it would be possible to work out fixed schedules for many merchant bar products. The experience gained in rolling in this manner would be very valuable when new high speed mills were being laid out. In some cases it has been found necessary, after the mill went into operation, to work out fixed rolling schedules on certain products to avoid roll breakage or heavy overloads on certain motors. It has been found that schedules thus worked out by studying reductions, roll pass design and motor loads can be used repeatedly, with entire success. Other mills have been found to operate best on certain products when rolling in accordance with the schedules used in the design of the mill. Thus, there is sufficient experience to indicate that more uniform rolling practice can be adopted with beneficial results.

FIG. 2—Driving motors of the tandem finishing train of a high speed band mill.

The type of edging stand and method of drive is usually a subject for considerable study. The present tendency seems to be toward the use of vertical rolls powered as heavily as the adjacent horizontal stands. The application of considerable power to small vertical rolls introduces mechanical problems. In a number of cases the rolls have been driven from below, through right angle drives and vertical pinions. The motors are standard horizontal machines mounted in pits below the mill floor level. In a right angle drive the amount of power which can be transmitted is limited by the space available for bevel gears. In some installations the right angle drive has been eliminated and vertical motors employed. As shown by Figure 1, in the latter arrangement the rolls, pinions and motor are all carried on a vertical structure. The motor is totally enclosed, force ventilated and its rotor is supported, as in a vertical waterwheel generator, by a Kingsbury thrust bearing at the top and a guide bearing at the bottom. One of the precautions to be taken in designing such a vertical structure is to avoid critical speeds of vibration within the operating range. The critical speeds are determined by the mass and stiffness of the structure. In the installation shown in the illustration, diagonal tubular bracing has been employed to insure that the lowest critical speed of the structure is well above the maximum operating speed.

Speed control and motor speed regulation are features which always receive considerable attention, especially when the mill is to roll a wide range of product at high speed. For such mills, all or a majority of the motors are direct current machines with speed range by field control of at least 2/1. All motors are controlled from one or two stations in the mill pulpit. The direct current motors are usually started by variable voltage control. Speed indicators, ammeters, rheostats and master switches for the loopers crop shear and flying shear give the operators complete control of the mill. Once the guides and rolls are adjusted to give the desired section, the operation of the mill is entirely in the hands of the pulpit crew.

The refinement of speed regulation required for successful operation depends upon a number of factors and practice has varied considerably. One of the first high speed mills to be built along present day lines was a band mill installed in 1928 in Cleveland. This mill has a tandem finishing train of 5 stands driven by individual motors. The stands are mounted on 7 foot centers. The delivery speed is 2700 ft. per minute. The finishing train motors were equipped with automatic speed regulators, which are still in use. The motors are shown in Figure 2. A mill similarly arranged but designed to roll rounds was installed in the same plant at about the same time. This mill also had automatic speed regulators for the finishing train which are also still in use. These mills were radically different from any other mills then in operation and it was felt that refinements in speed control should be included to insure successful operation.

Since the installation of the Cleveland mills; three similar high speed band mills have been built. Two of these mills have no automatic speed regulators and one has only 2 regulators which are used to synchronize small edger motors with the adjacent main stands. All of these later mills are rolling a satisfactory product. Experience has shown that extreme refinement of motor characteristics is not required for continuous mills rolling narrow flat material at high speed. It is very easy to provide for loops between stands and as long as the hot metal is prevented from coming under tension the size and shape of the loops seems to have little effect on the product. With good inherent motor speed regulation, a well designed high speed band mill will run with little attention from the pulpit operator. This is especially true when the motors are all operating at approximately the same percentage of rated capacity. Such division of load is not particularly difficult to obtain in a band mill. Likewise, when flat sections are rolled in a merchant mill, speed adjustments usu-

ally are not critical. The operation of a merchant bar mill tandem finishing train is also simplified somewhat by the stands being farther apart; the usual spacing required for loopers and other equipment being about 15 feet between centers.

Probably the first merchant mill to be installed which is representative of future mill design is a 14" tandem mill designed to roll medium and heavy merchant sections at speeds up to about 1800 feet per minute. Two 10" continuous merchant bar mills with individually driven intermediate and finishing stands and having delivery speeds up to 2000 feet per minute have also been in operation for several years. When rolling bolt stock, nut stock and similar light sections to close tolerances in a mill of this type, very accurate adjustments of speed and roll setting are required. Because of the high speed, the metal is finished at a high temperature. A very slight tension between stands in the finishing train will spoil the section. If the loops are too large, the bar will be scratched by the guides. In the roughing end of the mill it is necessary to run with a certain "looseness" between stands. A slight kink in the

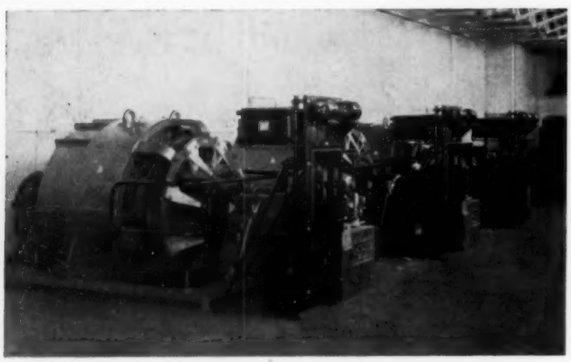

FIG. 3—Three of ten motors with automatic speed regulators on a 10" high speed merchant bar mill.

bar, caused by overfeeding of the preceding stand can easily cause the soft bar to catch on the guides, resulting in a cobble. If the bar is under tension at any point, even for an instant, that part of the finished bar will be undersize. Therefore, the rolling of accurate merchant bar is considerably more difficult than rolling hoop or band stock at the same or greater speeds.

Good speed regulation characteristics are actually more essential for the roughing stand motors than for the finishing stands. Between the finishing stands, changes in the loops indicate to the operator any variations in speed. Even with motors having mediocre speed regulation the pulpit operator can, if he devotes all his time to it, maintain proper loops. However, it is preferable to use motors with good speed regulation so that a minimum of speed adjustment is required. At the roughing end of the mill it is more difficult to obtain loops which will guide the operator and it is essential that the motor speed vary as little as possible with load and that the amount of adjustment be kept to the minimum. This is especially true where some of the roughing mill motors drive two stands, thus imposing four changes of load for each billet.

Of the three tandem merchant mills now in operation, one has automatic speed regulators for all motors. Figure 3 shows three of the ten motors and their speed regulators. The principal reason for using automatic speed regulators was to make it possible to raise and lower the speed of the entire mill without changing the bus voltage or disturbing the speed adjustments of the individual motors. Because of the wide range of product rolled and the pioneer nature of the installation, this was a valuable feature. The other tandem mills are designed for somewhat different rolling conditions and do not have automatic speed regulators. The performance of all mills is quite satisfactory. From the electrical engineer's standpoint, the principal interest in the installations described is that they demonstrate that electrical equipment is available for a wide range of operating conditions.

In laying out a new mill it is, of course, desirable to make the equipment as simple as possible without limiting the performance of the mill. Naturally, the use of automatic speed regulating equipment is to be avoided wherever experience shows it to be unnecessary. Dependable regulating equipment is available where the extra refinement it provides is desired.

The accuracy of finished section delivered at high speed is affected by the mechanical precision of the mill as well as by the performance of the electric drives. The rolls must be true and in perfect alignment and the bearings and housing must hold them in the correct position for long periods regardless of load. Within the past few years a great deal of research has been directed toward the improvement of rolling mill bearings. Any improvements which are made in bearings or methods of supporting and adjusting the rolls will improve the accuracy of the mill and simplify the electrical installation.

Considerable attention has been given to the design of small auxiliary planishing stands known as precision mills. Such mills are used to improve the accuracy of round stock as delivered from the main mill. Precision mills are all that the name implies, mechanically, and must be built with extreme care. They are usually driven by adjustable speed motors of less than 50 horsepower capacity. At first it was believed that it might be difficult to synchronize such precision stands with the main mill. Experience has shown that the speed adjustments are not critical and that a very simple electrical system is quite satisfactory. It has been found that by using a drive with drooping speed characteristics and adjusting the speed relations so that there is either a slight positive load or a slight negative load on the motor, very satisfactory operation is obtained.

Having rolled a satisfactory section, it is necessary to get the finished product away from the mill quickly so that the next billet can be started through the mill in the shortest possible time. Material which can be coiled is easily taken care of by a pin type coiler synchronized with the last stand of the mill. The speed of the coiler can be matched with that of the metal either by automatic control or with hand control and carefully matched tachometers. A neat coil can be obtained by means of automatic control which causes the speed of the coiler motor to vary slightly above and below the mean speed at regular intervals.

Sections which cannot be coiled must be deliver-

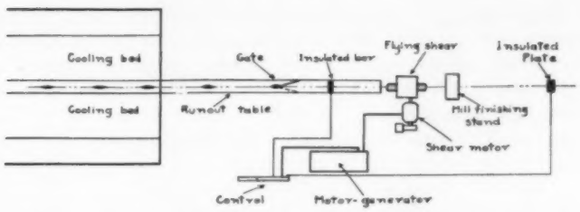

FIG. 4—Schematic diagram of automatic flying shear and cooling bed control.

ed to a cooling bed. Billets charged into the mill heating furnace are usually of such size that each billet will make a finished product several times longer than the cooling bed. It is necessary either to cut the billet to short lengths as it leaves the furnace and before it enters the mill or to cut the finished material after it leaves the last stand and while it is traveling at high speed. Cutting the finished product has the advantage that fewer separate pieces of metal pass through the mill. This gives less chance for scrap loss resulting from mill cobbles, as cobbles are usually caused by failure of the front end of a bar to enter the rolls properly.

To handle material delivered to the cooling bed at speeds up to approximately 2000 feet per minute, one of the continuous mills previously mentioned has been provided with a rotary type flying shear and control to operate the shear and hot bed automatically. Figure 4 shows the general arrangement of the equipment. The shear is driven by a special mill type motor supplied with power from an individual, variable-voltage flywheel motor generator. An electrically operated gate directs successive bars to the desired side of the hot bed. Figure 5 shows the shear motor generator and automatic control.

A bar leaving the mill passes through the shear and over an insulated plate on the runout table. As soon as the front end of a bar touches the plate, a contact is established that starts a motor-driven timing drum and closes the motor field forcing contactor. After a certain time, depending on the length to be cut and the speed at which metal is being delivered from the mill, the motor brake is released and the generator field is energized. The shear motor comes up to speed in approximately .6 seconds and the cut is made. A limit switch on the shear interrupts the generator field excitation and applies the magnetic brake so that the shear blades come to rest in the proper position by the combined action of regenerative current, brake friction, and shear friction. During this time the cooling bed gate is shifted so that the next bar will be deflected to the opposite side of the bed. The sequence for alternate cuts is controlled by either of two timing drums. Automatic control not connected with the shear control, operates the guides that deflect the finished bars from the roll table to the cooling racks and operates the rack-notching mechanism.

If, after making a number of full-length cuts, a piece remains that is shorter than the scheduled length, the shear control is locked out and the shear will not operate. This interlocking arrangement prevents the shear from making an off-length cut from the front end of the next oncoming bar, which may be following at an interval of a few feet. If the last bar from a billet is longer than scheduled length by a certain amount, a cut is made and the full length bar is sent to one side of the hot bed and the short length to the opposite side. If the last piece from a billet is only slightly longer than the scheduled length, no cut is made and the entire bar is deflected to the proper side of the hot bed.

Interlocking to insure proper action of the shear on the last length from each billet is obtained by a third timing drum. This timer is controlled by a plate contact on the looper between two of the finishing stands, energized through a relay by a small transformer, one terminal of which is grounded on the mill. A potential of 12 volts is used to avoid danger to the mill crew through accidental contact. Such plate contacts have been in use in this plant for a number of years and have been found reliable.

The speed of the shear blades at the instant of cut and the cut length are regulated from a small control desk in the mill pulpit. The control is synchronized with the mill finishing stand so that after adjustments are made, changes in mill speed will not affect the cut length or shear blade relative speed.

From the above brief discussion it will be evident that much of the mechanical and electrical ground

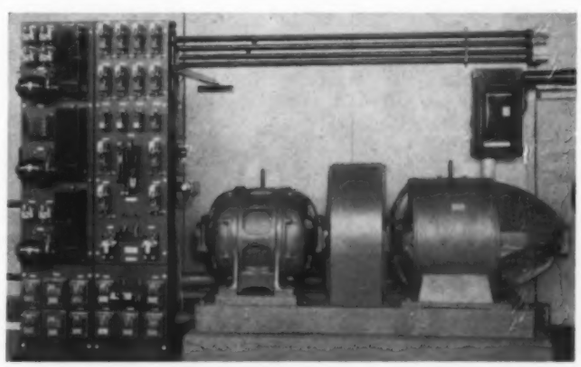

FIG. 5—Variable voltage motor-generator and field control for a high speed flying shear.

work leading to a general improvement in merchant mill practice has already been completed. Sufficient experience has been gained to show that electrical and mechanical equipment can be co-ordinated to meet the requirements of high speed precision rolling as the occasion arises for replacing older equipment.

Discussion

Discussion Presented by

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T. B. McElray, Supt. of Light & Power, Carnegie Steel Company, Youngstown District, Youngstown, Ohio.
R. E. Hough, Supt., Gautier Department, Bethlehem Steel Company, Johnstown, Pa.
H. J. Baugh, Supt., Bar & Hoop Mills, Carnegie Steel Co., Youngstown, Ohio.
H. G. R. Bennett, Asst. Gen. Supt., Carnegie Steel Company, Duquesne, Pa.
H. R. Mercer, Roll Shop Supt., Carnegie Steel Company, McDonald, Ohio.
R. H. Wright, Ind. Application Engineer, Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

L. A. Umansky: The paper just presented was certainly very interesting to all of us and the author should be congratulated on his presentation.

Mr. Wright very appropriately pointed out that the electrical equipment for the merchant mill consists of a combination of elements, each of which is well developed. The electrical engineer's task is to bring these elements into proper harmony, leaving the superfluous out of the picture.

This brings us at once to the problem of speed regulation of the main drives. In 1926 I had the privilege of addressing this association on this subject and of pointing out that this feature is often over stressed usually due to some misunderstanding as to what the speed regulation truly means.

If a tandem mill is equipped with individual drives for each stand, then many think that the speed of the driving motors should change very little from load to no-load. In other words, a close speed regulation is called for. The analysis which I presented to you in 1926 shows that in such a case it is of course important to set the relative speeds of the several motors rather accurately, under load condition, i.e., when the metal is in the rolls. It is not of much importance, how the motor speed will change when the metal is out of rolls. Thus there is not much reason for calling for a very close speed regulation of individual drives. Contrary to the common belief, a closer speed regulation is needed when a motor drives a group of stands, followed by another motor and a group of stands, all these stands being located in tandem and working on the same bar.

Experience fully bears out this reasoning. Take for instance the pioneer 14-inch tandem merchant mill of the Jones & Laughlin Steel Corp. It was installed in 1924, and is provided with individual drives for practically every stand. The mill is rolling a variety of merchant shapes at speeds up to 3000 ft./min. No special speed regulating equipment, nor series exciters, etc., were provided. None were found to be required in practice.

In 1926 two tandem merchant mills with individual drives were installed at Gary. Motors with normal (2-4%) speed regulation were successfully applied. This list can be extended to almost any desired length.

I know, of course, of a number of other merchant mills of this nature, where special and expensive speed regulators were installed. In practically all such cases these regulators were soon cut out, although they did all that was expected of them. They simply were found superfluous.

Of course, if Vernier field rheostats were left out, like in the case cited by Mr. Wright, and the regulators were the only means of fine speed adjustment, then the purchaser would have had to continue their use, regardless of the fact whether they were or were not justly called for in the first place. It simply means that it is sometimes cheaper to use an expensive device already paid for, than to buy a new device, even though a simpler and less expensive one.

Now, let us look at the roughing stands of a tandem merchant mill with individual drives. The bar is in several, if not in all, stands simultaneously. The bar is stiff, and cannot be looped. What is the criterion whether the relative speeds of the several stands are set correctly or not? Is the metal being stretched or compressed between the stands? There is only one criterion of this, as far as the motors are concerned, namely the motor load. In other words, the operator watching the motor ammeters, adjusts the motor relative speeds so as to set the motor loads at the proper values. Here again very fine speed adjusting (Vernier) rheostats are essential, but not a close speed regulation.

Electric drives for precision vertical stands for merchant mills, of which appreciable discussion was up for the last year or two should be also dealt with in the same manner. A strict synchronous-tie speed regulator between the mill drive and the vertical roll drive will not, in itself, solve the problem of successful rolling without pulling or pushing the metal. Some degree of drooping speed regulation of the vertical roll drive is essential. This characteristic will limit any tendency of the drive to "hog the load," i.e., to pull or push the bar too hard. Simplification rather than the complication of the equipment should be our goal.

T. B. McElray: In the application of regulators to steel mill main drive motors, we found one thing very important; that is the time required by a regulator to correct the speed of its motor. The first type of regulator tried on our 12" bar mill was the carbon pile type. While the variation of maximum to minimum pile compression occurs in a fraction of a second, this represents a gradual process as compared with the time required for the closing of the contacts of the vibrating regulator. Since in the case of a motor driving one roll stand, the increase from friction load to rolling load is often great and almost instantaneous, the performance of the carbon pile type of regulator was not satisfactory.

Application of the synchronous vibrating type has proven much better. The operators in this mill use the regulators on the roughing stands on all orders. Near the finishing end of the mill, however, this is not always the case, especially at high speeds. Some shapes seem to require a change in motor speed due to temperature or mechanical reasons. For example, a bar is proceeding with a normal loop between two stands; a greater loop suddenly forms. The operator must then speed up the motor until the loop again becomes normal and then slow down the motor to correct rolling speed to prevent a pull which would stretch the product. To accomplish this with the regulators in service, the operator has to operate a master switch which in turn runs a small motor, which, through a belt drive, changes the ratio of a reeves drive. All this inserts an element of time and uncertainty of exact amount of speed change, which is disasterous to quickly and safely reducing the loop to its proper amount. Therefore, the operator prefers hand control, because with the hand operated Vernier rheostat he can obtain a quicker and a more definite response.

The electronic regulator, which is now in the stage of development, may in the future offer a solution to many of these difficulties.

I believe, in building this type of high speed continuous mills, that the engineers should avoid driving two roughing stands with one motor and should try to stay as close to the two to one motor speeds as possible. I am sure with that arrangement, far better regulation could be obtained.

R. E. Hough: I would like to say a word as an operator, that I appreciate very much that the vari-

ables are recognized in producing precision material. Those most important are coordination of electrical-mechanical ends, and, as Mr. Wright said, schedules also must be arranged in order to do a better job.

H. J. Baugh: I would like to make one statement to incorporate what Mr. McElray said. In building such a type of mill it should all be independent units so far as the motor is concerned.

H. G. R. Bennett: I agree with Mr. McElray when he says we should attempt to keep our speed variable about two to one. In fact, I sometimes think we should provide methods for changing the gear ratio rather than the speed of motor to too great an extent.

In Mr. Wright's statement he mentioned the fact that the roll turners have not always stuck to original designs. I believe Mr. Mercer is in the room and we would like to hear him say something to us along that line.

H. R. Mercer: We have had to do a lot of things in that line to correct the trouble in our continuous mills. In fact, we have done things we wouldn't have thought of doing before we got into trouble. Of course on the finishing end of the continuous mills one cannot depart from the usual reductions, but in the roughing and intermediate stands we have had to change the original design of the passes to give us the right stock for the finishing passes.

R. H. Wright: In conclusion, as emphasized by Mr. Umansky's discussion, it is desirable to make any mill equipment as simple as possible. In this connection, there has been considerable divergence of opinion as to the value of automatic speed regulating equipment. This is largely because experience with this type of apparatus has been so varied. Experience now shows that some types of mills for which automatic speed regulators were at first thought necessary can be designed to operate without regulating equipment. Whether future merchant mills can use regulators to advantage or not will depend on the mill design and the range of product to be rolled. Any new installations involving untried features should be studied carefully and the mill design and electrical design closely coordinated regardless of the type of equipment used.

Mr. McElray's comment as to the desirability of individual drive for each stand of a tandem mill is very timely. This arrangement is especially valuable for the roughing trains of mills which are to roll a wide range of product.

Maintenance of Cranes

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A discussion pertaining to cranes is always interesting to those of us in the steel industry. Perhaps it is because cranes are such a widely used piece of equipment and are part of practically every operation in the processing of steel from the time the raw materials such as ore, coal and limestone enter the plant until the finished product is loaded on cars for shipment. They are also one of the most reliable pieces of equipment and if there were some way of measuring the total lifts made and the mileage traveled it would be surprising to find out how little time in a year a crane delay holds up operations. During the past twenty-five years there has been wonderful advancement made in the design and operation of cranes. This advancement has had a lot to do with expansion and increased production in our modern steel plants.

The subject of this paper concerns the maintenance of these cranes. One way of analyzing the subject is to investigate the causes of maintenance. This is a large subject with many angles and influenced by a multitude of operating problems. There are, however, some general conditions that affect maintenance of cranes that are often overlooked.

When speaking of cranes very often the track the crane runs on is not given serious consideration. For the same reason that modern railroads are so careful to keep their main line tracks in the best of condition, the crane runway should receive the same consideration. It has often happened that engineers in designing the buildings for a new mill have not taken crane design into account until it is too late. A crane must have a certain minimum end clearance between the trucks and the columns. In order to have good design, this end clearance is dependent on the distance between the runway rails and the column face. There are too many instances where crane builders have been forced to squeeze an end truck design into a narrow space and perhaps after the best they could do with crowding in, only a fraction of an inch clearance remained. Now building columns and runway rails do not stay in perfect alignment and installations of this sort are the beginning of one form of crane maintenance that is expensive to correct.

There is another dimension that is also important and that should be referred to the crane designers before buildings that house cranes are fully designed. That is the height from the runway rails to the lowest point of the roof trusses. Here, again, we find many monstrosities in crane design where the distance has been reduced below the sensible minimum and the crane designer is forced to many forms of freak design to crowd the height of the girders and trolley so that it will clear the roof trusses. I have seen several examples where this clearance was so small that rivets in the cross bracing of the trusses had to be countersunk and the sag of the trusses caused trouble. There have also been cases where the knee braces or gusset plates supporting the trusses were such that full trolley travel was not possible.

Three other conditions should also be brought into this picture. One concerns the bridge travel, one the trolley travel and the third the hoist travel.

Every crane should have bridge runway bumpers at the ends of travel. These bumpers limit the travel of the bridge and the extreme position of the hoisting cables or crane hook is limited by the position of these bumpers. How many installations do you know of where a few more feet in bridge travel would allow for a straight lift on the last stand of rolls or some piece of equipment that has had to be located close to the end of a building?

The travel of the trolley is likewise limited by the bumpers on the bridge girders. In trolley design, one end of the trolley can be laid out so that there is a minimum distance from the columns to the center line of the hook. This is not possible with the other end as the drum location determines which is the maximum travel end. The result of not taking this into consideration often means the hook cannot be centered over a loading track and swing lifts are necessary to load cars.

The third of these troubles concerns the hoist travel. The height of the runway is often determined before the crane is purchased or the mill or warehouse design is complete. This sometimes results in the discovery that every possible inch of travel of the hoist is necessary. Now most crane girders are of a form known as the "fish belly" type, which means they are thicker in the middle than they are at the ends. Hence a load can be lifted higher at the ends than in the middle. There are cranes in operation today where loads have to be transferred to either end in order to gain a few inches in hoisting. A direct result of such a practice is an ineffective limit switch. Practically all steel mill cranes are equipped with some reliable type of limit switch that will prevent over hoisting. Any of these switches need a certain distance in which to operate and allow time for the upward motion of hoisting to be stopped, usually from 18 to 30 inches. Now if every inch of headroom is needed for lifts, the limit switch cannot function and sooner or later the hook block will be pulled into the sheaves or drum and cables broken, and the load, hook, etc., fall to the ground.

These facts are called to your attention because even before a crane is put to work it is entirely possible for conditions to be already set up that will cause high maintenance and, more important still, operating hazards that will be both expensive to correct and difficult to explain.

There is one more case to be mentioned in the general discussion, that is the installation of a new crane on an old runway. Modern cranes are much sturdier and heavier than the old timers. Usually the new crane will be of a greater capacity than the old one that is on the runway. This means that greater wheel loads and end thrusts will be placed on the runway, and if it is one that had a narrow margin of safety in the first place with perhaps only 60 or 70 pound runway rails, maintenance on both runway and crane will soon be required.

Another phase of crane maintenance that is of interest is in the different types and ages of cranes. Most of us are associated with companies that have been in business for more than twenty-five years, and have equipment, particularly cranes, that date back that far. If we examine the apparatus of that vintage we will find riveted end trucks, perhaps track wheels with steel tires on cast iron centers, iron castings, everything bolted together and many parts overhung with nothing between them and the ground. The trolley wires are on the sides of the girders, there is no floor on the trolley or foot walk along the bridge. It is an ideal set up for parts and bolts to work loose and fall to the ground and nothing to stop them if they do. This type of design has been the target of many safety meetings, but they are still with us and hard to eliminate.

Now if these are contrasted with modern cranes we find steel end trucks either a one piece casting or welded; very few bolts and all steel castings; trolley bars instead of wire and mounted along a footwalk that extends to the girder; and the trolley usually a one piece casting floored over with only holes for the hoisting cables to go through. If these facts are compared we will find that maintenance problems hardly exist on modern cranes and if a part should become loose or break, the chances are it will never fall to the ground. The old cranes have hundreds of parts to come loose and nothing to stop them from falling. The new cranes have few parts to come loose or break and little chance of falling off the crane in case they should.

There are so many ramifications of this subject that it is difficult to include them in a short discussion of this type; without getting into the technique of crane design.

The type of electrical equipment also has its place in this discussion. Twenty-five years ago the modern crane and mill motor was not designed. We find the old motors have straight shafts and clumsy brakes on the main hoists of the cranes. Of the two, the old band brake with its solenoid gives the most trouble. Magnetic control was not far advanced so that drum controllers that worked in conjunction with brittle cast iron resistors were used. Overload panels and safety switches were not in the market. Many other pieces of apparatus that are now common were not to be had. Practically all of them were equipped with trolley wire that snapped off in the winter and sagged in the summer, held in place by strain insulators of uncertain strength. All these things contributed to making these old patriarchs an eternal job for electrical maintenance and perhaps had a lot to do with creating the impression that overhead

traveling cranes need an army of men to keep them running. With this type of crane it is true.

They have one more defect that should be mentioned—that is the bearings. For many years bearing design was a neglected art. Most any cylindrical substance would make a bearing, and oil grooves were left to the whims of the machinist. Bearing pressures received little consideration and the net result was a continual process of changing bearings with frequent instances of being too late and halves of the bearing falling out and down to the ground. Happily the anti-friction bearings came into the picture about fifteen years ago and caused sleeve bearing advocates to concentrate on this item so that modern cranes regardless of the type of bearing are practically immune to this trouble.

By means of facts such as these it can be proven that the new and modern cranes do not have a real maintenance problem when compared with the old ones and it is the latter type that should receive close consideration.

Another phase of this subject that is of extreme importance regardless of the type or age of the crane is the oiling of the parts. Any of us can remember when black oil was used for all purposes and poured all over the place under the guise of oiling the crane. Now we realize what an expensive operation this was and cranes today are as a rule properly oiled. It has been difficult during the last few years to carry out the oiling and greasing schedule, but those plants that kept their cranes oiled and greased saved both time and money in maintenance. It is folly, regardless of the mill operations, to claim that a certain time each twenty-four hours or each week cannot be set aside for proper oiling. If it is not done, more time than this requires will be lost in repairs later on.

The same reasoning can be applied to inspection, for a crane running twenty-four hours a day, seven days a week, needs to be looked over and the small jobs discovered before they grow into big ones.

The last phase of this part of the discussion concerns the drums, the cables, the hook and the load. The old drums were iron castings, the new ones are of steel. The original drum was made for a certain size of cable, say ½ inch. Often a larger cable, say ¾, has been substituted. In most cases this is wrong as the grooves will pinch the larger cable and both maintenance and hazards increase. Another mistake that affects both of these is changing the reeving of the cable to make a faster hoist and doubling the pull on the drum. By reducing the number of "whips" the pull or load on the cable raps is increased and perhaps passes the point of safe loading. Hooks likewise should be designed not just "made". It is seldom a hook breaks with overload. They are usually damaged then and sometime later break with perhaps only a light load.

A few years ago we were interested in compiling data to formulate a ruling on when the main cables on hot metal cranes should be changed, and prepared a list of questions whose answers would develop probable life of these cables. It was brought out that the long ton of the open hearth was used instead of the 2,000 pound ton of the crane designers and that the weight of the cables, beam, ladle, etc., were not given consideration. I believe a study of other cranes would bring forth similar information.

When the data concerning cable life was analyzed, so many factors such as size of sheaves, diameter of drum, care of cables, etc., entered into the problem that we could reach no conclusion. The cable manufacturers were asked to submit some rules on when a cable should be changed but they could not answer the question. "Send us a piece of your cable and we will test it, and send the result" was about the only answer we received. So many things can happen to a cable that are not discernable to the eye that a rule for probable life cannot be determined. Good judgment and proper care are the best advice we can give on this subject.

To round out this subject of factors entering into crane maintenance, two important ones remain. One of these is the crane operator. A crane must have care and judgment used in its operation just as any good machinery. These men have been given training on what to do and how to operate. Perhaps the biggest help they have is a book of rules on what to do and what not to do sponsored by the Safety Department. The craneman is the most important factor in the amount of crane repairs. Keep careful, keen cranemen and the cranes will not be abused.

The last of these factors is the man on the ground who is hooking on the lifts and directing the crane. He should be a partner with the craneman and not ask him to make unbalanced lifts, side pulls, swing lifts and many other things that are prohibited in the book of rules. The man on the ground can often prevent overhoisting by using a shorter sling, can eliminate a lot of spotty movements by good judgment in centering the hook, and can arrange his work so that the crane can be out of service at times to be oiled and inspected.

Why is crane maintenance necessary is answered for many installations by the foregoing remarks. A crane is a reliable piece of equipment but like any machine we must have the proper machine in the proper place, not a misfit or an undersized one. It must be treated fairly, oiled, greased and inspected. If these are done then crane maintenance is not a problem but only another job in a steel plant.

In closing let me emphasize that modern steel mill cranes are not just ordinary cranes. Since 1908 the Association of Iron and Steel Electrical Engineers have been constantly revising the standard specifications for steel mill overhead traveling cranes and carefully incorporating new ideas of materials and design that will make sturdy, reliable, safe cranes for the hard usage. The industry uses these specifications as a guide and the resulting cranes do a real job in the mill and are not found among the maintenance problems.

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D. M. Petty, Supt. Service Div., Bethlehem Steel Co., Bethlehem, Pa.

R. W. Schuette, Messinger Bearings, Inc., Pittsburgh, Pa.
J. Faris, Asst. to Vice Pres., Youngstown Sheet & Tube Co. Youngstown, Ohio.
R. H. DeMott, SKF Industries, Inc., Philadelphia, Pa.
J. M. Kelly, Hyatt Roller Bearing Co., Pittsburgh, Pa.
Fred Waldorf, Pittsburgh, Pa.
D. E. Batesole, Norma Hoffmann Bearings Corp., Stamford, Conn.
E. C. Gainsborg, Roller Bearing Co. of America, Trenton, N. J.
K. L. Herrmann, Bantam Ball Bearing Co., South Bend, Ind.
H. F. Brenholts, Fafnir Bearing Co., Pittsburgh, Pa.
Samuel Farrell, Rollway Bearing Co., Pittsburgh, Pa.
L. A. Cummings, Marlin Rockwell Corp., Jamestown, N. Y.
R. J. Harry, Sales Mgr., Alliance Machine Co., Alliance, Ohio.
D. A. Walters, Tyson Roller Bearing Co., Massillon, Ohio.
E. L. Upp, Elec. Supt., National Tube Co., McKeesport, Pa.
H. C. Mosley, Elec. Supt., Wheeling Steel Corp., Portsmouth, Ohio.
R. L. Brown, New Departure Mfg. Co., Bristol, Conn.
W. C. Suppler, Elec. Supt., Tennessee Coal, Iron & R. R. Co., Ensley, Ala.
C. J. Smith, Elec. Engr., Illinois Steel Co., So. Chicago, Ill.
E. C. Marshall, Elec. Supt., Youngstown Sheet & Tube Co. East Chicago, Ind.
R. F. Cheffin, Supt. Power, Pittsburgh Crucible Steel Co., Midland, Pa.
Sydney Buckley, Vice Pres., Shepard Niles Crane & Hoist Corp. Philadelphia, Pa.
William Jackson, Elec. Supt., Homestead Works, Carnegie Steel Co., Munhall, Pa.
F. H. Barnard, Sales Engr., Morgan Engineering Co., Alliance, Ohio.
Karl Runkle, Mgr. Sales, Mining & Steel Mill Section, General Electric Co., Schenectady, N. Y.
A. M. MacCutcheon, Vice Pres., Reliance Electric & Engineering Co., Cleveland, Ohio.
J. L. Brown, Mech. Engr., Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.
J. R. Lewis, Distr. Mgr., Crocker-Wheeler Elec. Mfg. Co., Pittsburgh, Pa.
W. E. Miller, Elec. & Mech. Supt., Bethlehem Steel Co., Johnstown, Pa.
G. E. Reiff, Allis Chalmers Mfg. Co., Norwood, Ohio.
C. C. Hutchins, Elliott Company, Ridgway, Pa.
W. C. Heinle, Chief Engr., Cleveland Crane & Engr. Co., Wickliffe, Ohio.
Wray Dudley, Elec. Engr., National Tube Co., Pittsburgh, Pa.
G. R. Carroll, Elec. Supt., Jones & Laughlin Steel Corp., Aliquippa, Pa.
Stanley Grand Girard, Chief Elec. Engr., Sharon Steel Hoop Co. Sharon, Pa.
T. J. Flaherty, Elec. Supt., American Rolling Mill Co., Ashland Ky.
L. V. Day, Works Engr., American Steel Foundries, East St. Louis, Ill.
J. A. Clauss, Chief Engr., Great Lakes Steel Corp., Ecorse, Mich.
W. Springfield, M. M., American Sheet & Tin Plate Co., Wellsville, Ohio.
T. B. McElray, Supt. Elec. Light & Power Dept., Carnegie Steel Co., Youngstown, Ohio.
J. S. Murray, Chief Elec. Engr., Follansbee Bros. Co., Follansbee, W. Va.
H. S. Griffith, Shaw-Box Crane & Hoist Company, Inc., Pittsburgh, Pa.
John L. Young, Ind. Div., Timken Roller Bearing Co., Pittsburgh, Pa.
F. P. May, Elec. Supt., Carnegie Steel Co., Mingo Junction, Ohio.

WELDING COMMITTEE

Chairman, Grover Hughes, Elec. Engr., Truscon Steel Co., Youngstown, Ohio.
A. W. Steed, Supt of Maint., American Rolling Mill Co., Middletown, Ohio.
R. M. Hussey, Supt. Rod and Wire Mills, Jones & Laughlin Steel Corp., Aliquippa, Pa.
A. J. Standing, Elec. Supt., Bethlehem Steel Co., Bethlehem, Pa.
J. H. McElhinney, Gen. Supt., Lukens Steel Co., Coatesville, Pa.
H. C. Mosley, Elec. Supt., Wheeling Steel Corp., Portsmouth, Ohio.
J. K. Rose, Elec. Supt., American Bridge Co., Pencoyd Plant, Pencoyd, Pa.
D. I. Bohn, Elec. Engr., Aluminum Company of America, Pittsburgh, Pa.
C. D. King, Metallurgist, U. S. Steel Corp., New York, N. Y.
Elbert Lewis, Asst. Elec. Engr., Illinois Steel Co., South Chicago, Ill.
F. P. May, Elec. Supt., Carnegie Steel Co., Mingo Junction, Ohio.
J. C. Reed, Elec. Engr. Bethlehem Steel Co., Stenlton, Pa.
W. W. Garrett, Engr. of Tests, Elec. Lab., Tennessee Coal, Iron & R. R. Co., Fairfield, Ala.
E. L. Upp, Elec. Supt., National Tube Co., McKeesport, Pa.
J. S. O'Donovan, Elec. Supt., Spang Chalfant Co., Inc., Etna, Pa.
Charles Schenk, Supt. of Prod., Bethlehem Steel Co., Bethlehem, Pa.
C. M. Myers, Asst. Elec. Engr., Youngstown Sheet & Tube Co., Youngstown, Ohio.
F. W. Cramer, Chief Elec. Engr., Republic Steel Corp., Youngstown, Ohio.
A. F. Davis, Vice Pres., Lincoln Electric Co., Cleveland, Ohio.
A. M. Candy, Engr., Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.
H. A. Winne, Industrial Eng. Dept., General Electric Co., Schenectady, N. Y.
A. B. Churchill, Elec. Supt., American Bridge Co., Ambridge, Pa.
E. H. Cocain, Chief Elec., Pittsburgh Steel Co., Monessen, Pa.

ELECTRIC HEAT COMMITTEE

Chairman, N. C. Bye, Chief Engr., Henry L. Disston & Sons, Inc., Tacony, Philadelphia, Pa.
Wirt Scott, Engr., Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.
R. H. Bryant, Elec. Engr., American Steel & Wire Co., Worcester, Mass.
R. W. Heller, Power Engr., Duquesne Light Co., Pittsburgh, Pa.
J. W. Bates, Elec. Engr., American Sheet & Tin Plate Co., Pittsburgh, Pa.
W. W. Wallis, Pres., Pittsburgh Electric Furnace Co., Pittsburgh Pa.
F. McQuillan, Industrial Sales Mgr., West Penn Power Co., Pittsburgh, Pa.
R. E. Brock, Asst. Supt., Heat Treating Dept., Spang Chalfant Co., Inc., Ambridge, Pa.
J. B. Jackson, Engr., Ohio Edison Co., Youngstown, Ohio.
George H. Schaeffer, Elec. Engr., Carpenter Steel Co., Reading, Pa.
R. J. Hartley, Engr., Simonds Saw & Steel Co., Lockport, N. Y.
E. N. Calhoun, Sales Mgr., Edwin L. Wiegand Co., Pittsburgh, Pa.
C. F. Cone, Engr., Geo. J. Hagan Co., Pittsburgh, Pa.
D. M. Petty, Supt. of Service Division, Bethlehem Steel Co., Bethlehem, Pa.
F. C. Watson, Elec. Engr., International Nickel Co., Huntington, W. Va.
Robert L. McIntosh, Indiana Harbor, Ind.
R. F. Benzinger, Vice Pres., Electric Furnace Co., Salem, Ohio.
E. F. Northrup, Vice Pres., Ajax Electrothermic Corp, Trenton, N. J.

W. C. Jahn, Engr., American Sheet & Tin Plate Co., Gary, Ind.
A. W. Duncan, Elec. Supt., Weirton Steel Co., Weirton, W. Va.
C. H. Fielding, Wks. Supt., Rustless Iron Corp., Baltimore, Md.
O. M. Svennson, Engr., Vanadium Corp. of America, Bridgeville, Pa.
M. H. Mawhinney, Salem Engineering Co., Salem, Ohio.

DEVELOPMENTS COMMITTEE

Chairman, W. H. Burr, Mech. and Elec. Supt., Lukens Steel Co., Coatesville, Pa.

Main Roll Division

G. E. Stoltz, Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.
J. D. Wright, General Electric Co., Schenectady, N. Y.
R. W. Davis, Allis Chalmers Mfg. Co., Milwaukee, Wis.
W. H. Feldman, Electric Machinery Mfg. Co., Minneapolis, Minn.
B. D. Christian, Crocker-Wheeler Elec. Mfg. Co., Ampere, N. J.
C. C. Hutchins, Elliott Co., Ridgway, Pa.

Auxiliary Drives and General Purpose Motors Division

R. H. Wright, Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.
A. M. MacCutcheon, Reliance Elec. & Engr. Co., Cleveland, Ohio.
J. R. Lewis, Crocker-Wheeler Elec. Mfg. Co., Pittsburgh, Pa.
C. C. Hutchins, Elliott Co., Ridgway, Pa.
J. C. Barry, General Electric Co., Erie, Pa.
W. H. Powell, Allis Chalmers Mfg. Co., Milwaukee, Wis.
R. H. Newton, Lincoln Electric Co., Cleveland, Ohio.
J. M. Moore, Sterling Electric Motors, Inc., Pittsburgh, Pa.
J. T. Ryan, Century Electric Co., Pittsburgh, Pa.
J. S. Smith, Wagner Electric Co., Pittsburgh, Pa.
H. H. Harpster, Imperial Electric Co., Pittsburgh, Pa.

Control Division

T. S. Towle, Cutler-Hammer, Inc., Pittsburgh, Pa.
W. H. Williams, Clark Controller Co., Cleveland, Ohio.
R. G. Widdows, Electric Controller & Mfg. Co., Cleveland, Ohio.
H. A. Winne, General Electric Co., Schenectady, N. Y.
D. W. Dean, Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.
Joseph F. Frese, Monitor Controller Co., Baltimore, Md.
J. S. Rowan, Rowan Controller Co., Baltimore, Md.

Crane Division

G. W. Yanney, Alliance Machine Co., Alliance, Ohio.
F. H. Barnard, Morgan Engineering Co., Alliance, Ohio.
W. C. Heinle, Cleveland Crane & Engineering Co., Wickliffe, Ohio.
H. S. Griffith, Shaw-Box Crane & Hoist Company, Inc., Pittsburgh, Pa.
Sydney Buckley, Shepard Niles Crane & Hoist Corp., Montour Falls, N. Y.
A. J. Dreyer, Harnischfeger Corp., Pittsburgh, Pa.
A. J. Brown, Whiting Corp., Chicago, Ill.

Transmission Equipment Division

F. E. Fairman, General Electric Co., Philadelphia, Pa.
N. C. Goin, Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.
R. E. Uptegraff, R. E. Uptegraff Mfg. Co., Pittsburgh, Pa.
A. H. Dyckerhoff, Commonwealth Edison Co., Chicago, Ill.
Samuel Horelick, Pennsylvania Transformer Co., Pittsburgh, Pa.
G. L. Crosby, Roller Smith Co., New York N. Y.
W. M. Scott, I-T-E Circuit Breaker Co., Philadelphia, Pa.
J. K. Keogh, Allis Chalmers Mfg. Co., Pittsburgh, Pa.
A. F. Alsaker, Delta Star Electric Co., Chicago, Ill.
J. J. Mullen, Moloney Electric Co., St. Louis, Mo.
J. S. Livingston, Schweitzer & Conrad, Inc. Chicago, Ill.
L. B. Gawthrop, Electric Service Supplies Co., Philadelphia, Pa.
B. M. Jones, Duquesne Light Co., Pittsburgh, Pa.
R. L. Baker, Metropolitan Edison Co., Reading, Pa.
M. E. Noyes, Aluminum Company of America, Pittsburgh, Pa.
H. E. Ransford, G. & W. Electric Specialties Co., Pittsburgh, Pa.
P. Maher, General Cable Corp., New York N. Y.
J. J. O'Brien, Okonite Company, Chicago, Ill.
J. S. Rashba, Rockbestos Products Corp., Pittsburgh, Pa.
A. N. Cartwright, West Penn Power Co., Pittsburgh, Pa.

Generating Equipment Division

R. H. Wright, Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.
Paul Caldwell, General Electric Co., Pittsburgh, Pa.
W. H. Powell, Allis Chalmers Mfg. Co., Milwaukee, Wis.
L. O. Gregg, Elliott Company, Pittsburgh, Pa.
J. R. Lewis, Crocker-Wheeler Elec. Mfg. Co., Pittsburgh, Pa.

Miscellaneous Division

H. Lee Reynolds, H. Lee Reynolds Co., Pittsburgh, Pa.
J. J. Bangert, Crouse-Hinds Co., Pittsburgh, Pa.
M. S. Robinson, Erie Malleable Iron Co., Pittsburgh, Pa.
A. E. Tregenza, Jefferson Electric Co., Bellwood, Ill.
F. M. Currie, Pyle National Co., Chicago, Ill.
B. M. Slicting, Trico Fuse Mfg. Co., Milwaukee, Wis.
W. C. Anderson, Trumbull Elec. Mfg. Co., Pittsburgh, Pa.
W. L. DeCoursey, Economy Fuse & Mfg. Co., Pittsburgh, Pa.
G. L. Stout, Colt's Patent Fire Arms Mfg. Co., Pittsburgh, Pa.
H. E. Burns, H. E. Burns Co., Pittsburgh, Pa.
E. B. Beach, E. B. Beach Company, Pittsburgh, Pa.
E. S. Stickle, E. S. Stickle Co., Pittsburgh, Pa.
H. E. Slack, Bussmann Mfg. Co., Pittsburgh. Pa.
T. M. Rees, Rees Machinery Co., Pittsburgh, Pa.

Instruments

R. M. Walker, Bristol Company, Chicago, Ill.
A. R. Richardson, General Electric Co., Philadelphia, Pa.
G. L. Crosby, Roller Smith Co., New York, N. Y.
R. W. Leech, Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.
L. D. Joralemon, Weston Electrical Instrument Corp., Philadelphia, Pa.
L. O. Morrow, Esterline-Angus Co., Philadelphia, Pa.
G. D. Conlee, Republic Flow Meters Co., Chicago, Ill.
C. L. Clapper, Brown Instrument Co., Pittsburgh, Pa.
I. M. Stein, Leeds & Northrup Co., Philadelphia, Pa.

SPECIAL MAGNETIC CONTROL COMMITTEE

Chairman, E. L. Upp, Elec. Supt., National Tube Co., McKeesport, Pa.
C. J. Smith, Elec. Engr., Illinois Steel Co., South Chicago, Ill.
E. C. Marshall, Elec. Supt., Youngstown Sheet & Tube Co., East Chicago, Ind.
R. E. Lewis, Elec. Supt., Youngstown Sheet & Tube Co., Youngstown, Ohio.
J. I. Kaspari, Asst. Elec. Engr., Weirton Steel Co., Weirton, W. Va.
D. I. Bohn, Elec. Engr., Aluminum Company of America, Pittsburgh, Pa.
F. D. Egan, Elec. Supt., Bethlehem Steel Co., Lackawanna, N. Y.
H. F. Raab, Asst. Elec. Supt., Bethlehem Steel Co., Johnstown, Pa.
J. R. Barefoot, Asst. Elec. Supt., Carnegie Steel Co., Munhall, Pa.
R. F. Sanner, Asst. Supt. of Maintenance Dept., Carnegie Steel Co., Duquesne, Pa.
J. W. Bates, Elec. Engr., American Sheet & Tin Plate Co., Pittsburgh, Pa.
W. H. Burr, Elec. and Mech. Supt., Lukens Steel Co., Coatesville, Pa.
J. O'Malia, Ch. Elec., Otis Steel Co., Cleveland, Ohio.
W. W. Garrett, Engr. of Tests, Elec. Lab., Tennessee Coal, Iron & R. R. Co., Fairfield, Ala.
O. H. Meineke, Elec. Supt., Spang Chalfant Co., Inc., Ambridge, Pa.

W. F. Riggs, Elec. Supt., Jones & Laughlin Steel Corp., S. S. Works, Pittsburgh, Pa.
J. A. Morgan, Asst. Supt., Maintenance Dept., Carnegie Steel Co., Braddock, Pa.
C. H. Verwohlt, Works Engr., Wheeling Steel Corp., Wheeling, W. Va.
J. G. Gage, Gen. Supt., American Rolling Mill Co., Butler, Pa.
J. B. Sullivan, Elec. Supt., A. M. Byers Co., Ambridge, Pa.
J. Maloney, Chief Elec., Superior Steel Corp., Carnegie, Pa.
J. D. Kelvie, Chief Elec., Republic Steel Corp., Massillon, Ohio.
L. M. Ripple, Elec. Supt., Great Lakes Steel Corp., Ecorse, Mich.
W. A. Perry, Supt. Elec. & Pwr. Depts., Inland Steel Co., East Chicago, Ind.
F. H. Kittredge, Elec. Engr., Illinois Steel Co., Joliet, Ill.
J. S. Delaney, Chief Elec., Granite City Steel Co., Granite City, Ill.
C. T. Phillips, Elec. Supt., Sheffield Steel Corp., Kansas City, Mo.
I. N. Tull, Elec. Engr., Corrigan-McKinney Steel Co., Cleveland, Ohio.
R. S. Hurtt, Elec. Dept., Pittsburgh Crucible Steel Co., Midland, Pa.
F. A. Snyder, Elec. Engr., American Steel & Wire Co., Cleveland, Ohio.
E. L. Anderson, Elec. Dept., Bethlehem Steel Co., Sparrows Point, Md.

ILLUMINATION COMMITTEE

Chairman, R. F. Sanner, Asst. Supt. of Maintenance Dept., Carnegie Steel Co., Duquesne, Pa.
P. C. Keller, Ivanhoe Div. of Miller Co., Cleveland, Ohio.
S. G. Hibben, Comm. Mgr., Westinghouse Lamp Co., Bloomfield, N. J.
H. J. Walters, Asst. Elec. Supt., Jones & Laughlin Steel Corp., Pittsburgh, Pa.
A. R. Lintern, Secretary, Nichols-Lintern Co., Cleveland, Ohio.
E. H. Cocain, Chief Elec., Pittsburgh Steel Co., Monessen, Pa.
J. D. Scully, Asst. Elec. Supt., National Tube Co., McKeesport, Pa.
J. C. Booher, Chief Elec., American Steel & Wire Co., Donora, Pa.
E. O. Austermiller, Asst. Elec. Engr., Wisconsin Steel Works, So. Chicago, Ill.
A. J. Thompson, Pres., Thompson Electric Co., Cleveland, Ohio
J. C. Ritchey, Elec. Engr., Pressed Steel Car Co., McKees Rocks, Pa.
Carlton Ostrom, Sales Engr., Benjamin Electric Mfg. Co., Pittsburgh, Pa.
F. A. Tremallen, Foreman Pwr. Hse. Lines, Bethlehem Steel Co., Johnstown, Pa.
J. R. Ibach, Elec. Supt., Aluminum Company of America, Massena, N. Y.
J. J. Bangert, Sales Engr., Crouse-Hinds Company, Pittsburgh, Pa.
H. C. Canon, Chief Elec., Babcock & Wilcox Tube Co., Beaver Falls, Pa.

PORTABLE ELECTRICAL TOOL COMMITTEE

Chairman, P. W. Miller, Asst. Elec. Supt., Carnegie Steel Co., Clairton, Pa.
W. C. Buske, M. M., McConway & Torley Co., Pittsburgh, Pa.
A. F. Jones, Chief Elec., Champion Machine & Forging Co., Cleveland, Ohio.
F. M. Sturgess, Chief Elec., American Steel & Wire Co., Fairfield, Ala.
H. L. Coe, Elec. Engr., Carnegie Steel Co., Mingo Junction, Ohio.
W. C. McClelland, Elec. Supt., Standard Tin Plate Co., Canonsburg, Pa.
George H. McFeaters, Elec. Engr., Lorain Steel Co., Johnstown, Pa.
G. J. Walz, Asst. Elec. Engr., Bethlehem Steel Co., Steelton, Pa.
S. E. McQuigg, Chief Elec., Allegheny Steel Co., Brackenridge, Pa.
P. J. McGrane, Chicago Heights, Ill.
James Maloney, Chief Elec., Superior Steel Corp., Carnegie, Pa.
Henry Molz, Chief Elec., Allegheny River Mining Co., Kittanning, Pa.
J. R. Penman, Elec. Supt., Reading Iron Co., Reading, Pa.
J. S. O'Donovan, Elec. Supt., Spang Chalfant Co., Inc., Etna, Pa.
W. J. Davis, Chief Elec., Scullin Steel Co., St. Louis, Mo.
H. F. Raab, Asst. Elec. Supt., Bethlehem Steel Co., Johnstown, Pa.
D. W. McFayden, Chief Elec., Universal Portland Cement Co., Universal, Pa.
William Anderson, Chief Elec., Sellers Mfg. Co., Chicago, Ill
James Riles, Pittsburgh, Pa.
J. R. Lytle, Chief Elec., Vulcan Mould & Iron Co., Latrobe, Pa.
James H. Reiners, Mgr., Pittsburgh Screw & Bolt Co., N. S., Pittsburgh, Pa.
George Pfeffer, Elec. Supt., Florence Pipe Foundry & Machine Co., Florence, N. J.
J. C. Ritchey, Elec. Engr., Pressed Steel Car Co., McKees Rocks, Pa.
R. F. Waldo, Dist. Mgr., Ideal Commutator Dresser Co., Pittsburgh, Pa.
H. McFarland, Sales Mgr., Martindale Electric Co., Cleveland, Ohio.
A. L. Krumhaus, Chief Elec., Globe Steel Tube Co., Milwaukee, Wis.

COMMUTATION COMMITTEE

Chairman, O. H. Meineke, Elec. Supt., Spang Chalfant Co., Inc., Ambridge, Pa.
J. Walter Becker, Ideal Commutator Dresser Co., Sycamore, Ill.
A. S. Bemis, Speer Carbon Company, St. Marys, Pa.
A. M. Ramsey, LeCarbone Company, Pittsburgh, Pa.
E. G. Gerber, Diamond Carbon Co., Pittsburgh, Pa.
R. F. Hausen, Pittsburgh Carbon Brush Co., Pittsburgh, Pa.
P. D. Manbeck, National Carbon Co., Inc., Cleveland, Ohio.
J. S. Marcus, Electro-Nite Carbon Co., Philadelphia, Pa.
E. H. Martindale, Martindale Electric Co., Cleveland, Ohio.
Wm. Siebenmorgan, Electro Service Inc., Union City, N. J.
Carl L. Sittler, Pure Carbon Co., Chicago, Ill.
Geo. P. Mountford, Ohio Carbon Co., Cleveland, Ohio.
J. H. Albrecht, Calebaugh Carbon Co., Pittsburgh, Pa.
A. T. Kelly, Stackpole Carbon Co., St. Marys, Pa.
F. B. Godard, U. S. Graphite Co., Pittsburgh, Pa.
E. A. Lapham, Morganite Brush Co., Inc., New York, N. Y.
R. J. Cook, Superior Carbon Co., Cleveland, Ohio.

AIR CONDITIONING COMMITTEE

Chairman, T. J. Flaherty, Elec. Supt., American Rolling Mill Co., Ashland, Ky.
R. E. Lewis, Elec. Supt., Youngstown Sheet & Tube Co., Youngstown, Ohio.
J. H. Milliken, American Air Filter Co., Inc., Chicago, Ill.
T. E. Hughes, Supt., Maintenance & Mechanical Departments, Carnegie Steel Co., Duquesne, Pa.
W. H. Beyerly, Asst. Elec. Supt., Bethlehem Steel Co., Sparrows Point, Md.
G. R. Carroll, Elec. Supt., Jones & Laughlin Steel Corp., Aliquippa, Pa.
W. S. Hall, Supt. Engr. and Constr., Illinois Steel Co., South Chicago, Ill.
J. E. Sayer, Asst. Chief Elec., Tennessee Coal, Iron & R. R. Co., Ensley, Ala.
J. D. Donovan, Elec. & Mech. Supt., Republic Steel Corp, Massillon, Ohio.

TRANSPORTATION COMMITTEE

Chairman, G. N. Harmon, Elec. Supt., Republic Steel Corp., Warren, Ohio.
J. W. Bates, Elec. Engr., Power Div., American Sheet & Tin Plate Co., Pittsburgh, Pa.
George H. Criss, H. E. McCoy Co., Pittsburgh, Pa.
A. H. Candee, Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.
R. S. Richards, Atlas Car & Mfg. Co., Cleveland, Ohio.
L. N. Crissman, Electric Storage Battery Co., Pittsburgh, Pa.
J. K. Mahaffey, Edison Storage Battery Co., Pittsburgh, Pa.
G. M. Barker, Philadelphia Storage Battery Co., Pittsburgh, Pa.
S. L. Henderson, Elec. Supt., American Steel & Wire Co., Central Fces., Cleveland, Ohio.
G. W. Black, Elec. Supt., Carnegie Steel Co., Clairton, Pa.
M. Nesbit, Automatic Transportation Co., Pittsburgh, Pa.
C. H. Moeller, Yale & Towne Mfg. Co., Pittsburgh, Pa.
L. F. Meissner, Mercury Mfg. Co., Pittsburgh, Pa.
C. B. Cook, Elwell Parker Electric Co., Cleveland, Ohio.
L. W. Long, Supt. of Maintenance, National Tube Co., Lorain Ohio.

SHOP PRACTICES COMMITTEE

Chairman, E. C. Marshall, Elec. Supt., Youngstown Sheet & Tube Co., East Chicago, Ind.
O. H. Meineke, Elec. Supt., Spang Chalfant Co., Inc., Ambridge, Pa.
W. A. Perry, Supt. Elec. & Power Depts., Inland Steel Co., East Chicago, Ind.
George Pfeffer, Elec. Supt., Florence Pipe Foundry & Machine Co., Florence, N. J.
S. G. Rainbow, Asst. Elec. Supt., Jones and Laughlin Steel Corp., Aliquippa, Pa.
L. R. Rankin, Elec. Supt., Carnegie Steel Co., Farrell, Pa.
F. S. Auer, Asst. Elec. Supt., Carnegie Steel Co., New Castle, Pa.
R. F. Gale, Plant Engr., Midvale Company, Nicetown, Philadelphia, Pa.
W. W. Barefoot, Elec. Supt., Carnegie Steel Co., McKees Rocks, Pa.
C. E. Miller, Elec. Dept., Carnegie Steel Co., Clairton, Pa.
J. S. Murray, Chief Elec. Engr., Follansbee Bros. Co., Follansbee, W. Va.
Paul Canney, Elec. Supt., Minnesota Steel Co., Duluth, Minn.
G. N. Hughes, Elec. Supt., Gulf States Steel Co., Alabama City, Ala.
H. S. Harding, Elec. Shop Foreman, Great Lakes Steel Corp., Ecorse, Mich.
G. N. Harmon, Elec. Supt., Republic Steel Corp., Warren, Ohio.

COMBUSTION ENGINEERING DIVISION

EXECUTIVE COMMITTEE

Engineering Section Director, Chairman, J. L. Miller, Asst. Chief Engr., Carnegie Steel Co., Youngstown, Ohio.
Secretary, T. J. Ess, Comb. Engr., Republic Steel Corp., Massillon, Ohio.
F. E. Leahy, Fuel Engr., Youngstown Sheet & Tube Co., Youngstown, Ohio.
W. N. Flanagan, Spec. Engr., Carnegie Steel Co., Pittsburgh, Pa.
H. V. Flagg, Asst. Comb. Engr., American Rolling Mill Co., Middletown, Ohio.
Martin J. Conway, Comb. Engr., Lukens Steel Co., Coatesville, Pa.
H. C. Siebert, Comb. Engr., Bethlehem Steel Co., Bethlehem, Pa.

Gas Utilization Section

Chairman, G. T. Hollett, Comb. Engr., Illinois Steel Co., South Chicago, Ill.
W. N. Flanagan, Spec. Engr., Carnegie Steel Co., Pittsburgh, Pa.
A. G. Witting, Chief Engr., Illinois Steel Co., Gary, Ind.
J. G. West, Jr., Asst. Gen. Mgr., Jones & Laughlin Steel Corp., Pittsburgh, Pa.
A. J. Boynton, Vice President, H. A. Brassert & Co., Chicago, Ill.
W. H. Cosgrove, Pres., Gas Combustion Co., Pittsburgh, Pa.
H. Dobrin, Consulting Fuel Engr., Pittsburgh, Pa.
W. E. Bisler, Engr., Combustion Engr. Corp., New York, N. Y.
J. C. Hayes, Engr., Freyn Engineering Co., Chicago, Ill.
Karl L. Landgrebe, Vice Pres., Tennessee Coal, Iron & R. R. Co., Birmingham, Ala.
J. W. Jones, Steam Engr., Wheeling Steel Corp., Portsmouth, Ohio.
Wilfred Sykes, Asst. to Pres., Inland Steel Co., Chicago, Ill.
W. J. McGurty, Bartlett Hayward Co., Pittsburgh, Pa.
C. W. Hedberg, Research Corp., Bound Brook, N. J.
R. R. Harmon, Chemical Engr., Peabody Engineering Corp., New York, N. Y.

Gas Producer Section

Chairman, F. E. Leahy, Fuel Engr., Youngstown Sheet & Tube Co., Youngstown, Ohio.
A. L. Foell, Chief Engr., Arthur G. McKee & Co., Cleveland, Ohio.
L. C. Edgar, Chief Engr., Edgar Thomson Works, Carnegie Steel Co., Braddock, Pa.
C. W. Phillips, Gen. M. M., Republic Steel Corp., Warren, Ohio.
L. F. Coffin, Supt. Mech. Dept., Bethlehem Steel Co., Sparrows Point, Md.
W. J. Harper, Chief Comb. Engr., Republic Steel Corp., Youngstown, Ohio.
H. C. Siebert, Comb. Engr., Bethlehem Steel Co., Bethlehem, Pa.
S. M. Jenks, Fuel Engr., American Sheet & Tin Plate Co., Pittsburgh, Pa.
G. A. Merkt, Engineer, Industrial Control Dept., Morgan Construction Co., Worcester, Mass.

Furnace Section

Chairman, G. M. Coughlin, Comb. Engr., American Rolling Mill Co., Ashland, Ky.
F. G. Gasche, Comb. Eng., Buffalo, N. Y.
H. C. Siebert, Comb. Engr., Bethlehem Steel Co., Bethlehem, Pa.
A. W. Steed, Supt. Maint., American Rolling Mill Co., Middletown, Ohio.
Karl H. Marsh, Chief Engr., British Empire Steel Corp., Sydney, N. S., Canada.
G. T. Hollett, Comb. Engr., Illinois Steel Co South Chicago, Ill.
L. Ellman, Vice Pres., M. H. Detrick Co., Pittsburgh, Pa.
Joseph Kennedy, Julian Kennedy Co., Pittsburgh, Pa.
W. R. Culbertson, Dist. Mgr., Rust Engineering Co., Pittsburgh, Pa.
G. R. McDermott, Vice Pres., Chapman Stein Div., Surface Combustion Corp., Toledo, Ohio.
E. H. Younglove, Johns Manville, Inc., Chicago, Ill.
A. G. Witting, Chief Engr., Illinois Steel Co., Gary, Ind.
John Lehnert, Comb. Engr., Republic Steel Corp., Massillon, Ohio.
C. H. Hunt, Asst. to Pres., Weirton Steel Co., Weirton, W. Va.
S. Naismith, Refractory Engr., Illinois Steel Co., South Chicago Ill.
W. P. Chandler, Special Eng., Blaw Knox Co., Blawnox, Pa.
A. V. Ritts, Chief Engr., Costello Engr. Co., Pittsburgh, Pa.
W. H. Cosgrove, Pres., Swindell-Dresser Corp., Pittsburgh, Pa.
G. A. Merkt, Industrial Control Dept., Morgan Construction Co., Worcester, Mass.
Lee Wilson, Pres., Lee Wilson Engineering Co., Cleveland, Ohio.

Steam Generation and Utilization Section

Chairman, A. G. Witting, Chief Engr., Illinois Steel Co., Gary, Ind.

L. C. Edgar, Chief Engr., Edgar Thomson Works, Carnegie Steel Co., Braddock, Pa.
E. W. Trexler, Steam Engr., Bethlehem Steel Co., Johnstown, Pa.
J. B. Crane, Engr., Combustion Engineering Corp., Pittsburgh, Pa.
James Rath, Power Dept., National Tube Co., McKeesport, Pa.
S. H. McKee, Consulting Engineer, Youngstown, Ohio.
E. Kieft, Engr. of Tests, Illinois Steel Co., Gary, Ind.
C. H. Verwohlt, Works Engr., Wheeling Steel Corp., Wheeling, W. Va.
A. L. Penniman, Jr., Supt. Steam Station, Consolidated Gas, Electric, Light & Power Co., Baltimore, Md.
E. C. McDonald, Asst. Steam Engr., Republic Steel Corp., Buffalo, N. Y.
C. H. Williams, Steam Engr. Dept., Carnegie Steel Co., Youngstown, Ohio.
E. P. Winters, Power Engr., Sloss Sheffield Steel & Iron Co. North Birmingham, Ala.
L. F. Fairthorne, Battelle Memorial Institute, Columbus, Ohio.

Liquid Fuel Section

Chairman, W. J. Harper, Chief Comb. Engr., Republic Steel Corp., Youngstown, Ohio.
A. G. Witting, Chief Engr., Illinois Steel Co., Gary, Ind.
Joseph G. Walsh, Asst. Gen. Supt., Republic Steel Corp., Birmingham, Ala.
A. W. Steed, Supt. Maint., American Rolling Mill Co., Middletown, Ohio.
F. G. Gasche, Comb. Engr., Buffalo, N. Y.
H. C. Siebert, Comb. Engr., Bethlehem Steel Co., Bethlehem, Pa.
A. K. McMillen, Chief Engr., Alex Laughlin & Co., Pittsburgh, Pa.
Karl H. Marsh, Chief Engr., British Empire Steel Co., Sydney, N. S., Canada.
G. T. Hollett, Comb. Engr., Illinois Steel Co., South Chicago, Ill.
L. Ellman, Vice Pres., M. H. Detrick Co., Pittsburgh, Pa.
Joseph Kennedy, Julian Kennedy Co., Pittsburgh, Pa.
W. R. Culbertson, Distr. Mgr., Rust Engineering Co., Pittsburgh, Pa.
G. R. McDermott, Vice Pres., Chapman Stein Div., Surface Combustion Corp., Toledo, Ohio.
John Lehnert, Comb. Engr., Republic Steel Corp., Massillon, Ohio.
C. H. Hunt, Asst. to Pres., Weirton Steel Co., Weirton, W. Va.
S. Naismith, Refractory Engr., Illinois Steel Co., South Chicago, Ill.
W. P. Chandler, Jr., Spec. Engr., Blaw Knox Co., Blawnox, Pa.

Instrument and Control Section

Chairman, M. J. Conway, Comb. Engr., Lukens Steel Co., Coatesville, Pa.
J. Wallace, M. M., Wheeling Steel Corp., Benwood Works, Wheeling, W. Va.
J. C. Allen, Asst. Chief Engr., Carnegie Steel Co., Mingo Junction, Ohio.
Geo. M. Coughlin, Combustion Engineer, American Rolling Mill Co., Ashland, Ky.
Carl Fischer, Supt. Light, Heat and Power, Mesta Machine Co., West Homestead, Pa.
R. M. Walker, Dist. Mgr., Bristol Co., Chicago, Ill.
G. D. Conlee, Chief Engr., Republic Flow Meters Co., Chicago, Ill.
J. M. Hopwood, Pres., Hagan Corporation, Pittsburgh, Pa.
J. E. Dunn, Comb. Engr., A. M. Byers Co., Ambridge, Pa.
M. J. Bradley, Leeds & Northrup Co., Philadelphia, Pa.
C. L. Clapper, Brown Instrument Co., Pittsburgh, Pa.
P. S. Dickey, Bailey Meter Co., Cleveland, Ohio.
R. W. Simpson, American Heat Economy Bureau, Inc., Pittsburgh, Pa.

SAFETY ENGINEERING DIVISION

EXECUTIVE COMMITTEE

Engineering Section Director

E. F. Blank, Director of Safety and Welfare, Jones & Laughlin Steel Corp., Aliquippa, Pa.
Chairman, J. A. Voss, Director of Industrial Relations, Republic Steel Corp. Youngstown, Ohio.
C. E. Sankey, Chief Safety Director, National Tube Co., Pittsburgh, Pa.
C. L. Baker, Management's Repr., Bethlehem Steel Co., Lackawanna, N. Y.
R. G. Adair, Asst. Works Mgr., American Rolling Mill Co., Butler, Pa.
J. A. Oertel, Safety Director, Carnegie Steel Co., Pittsburgh, Pa.
A. C. Germain, Safety Director, Minnesota Steel Co., Duluth, Minn.
H. G. Hensel, Safety Engr., Youngstown Sheet & Tube Co., Indiana Harbor, Ind.
F. H. Rowe, Safety Engr., Wheeling Steel Corp., Portsmouth, Ohio.
P. F. Haberstick, Safety Engr., Wheeling Steel Corp., Wheeling, W. Va.
P. G. Fenlon, Safety Director, Carnegie Steel Co., Duquesne, Pa.
J. F. Hunter, Safety Engr., Carnegie Steel Co., Pittsburgh, Pa.
F. H. Kittredge, Elec. Supt., Illinois Steel Co., Joliet, Ill.
Stanley Grand Girard, Chief Elec. Engr., Sharon Steel Hoop Co., Sharon, Pa.
G. A. Lamberton, Gen. Foreman, National Tube Co., Lorain, Ohio.
W. B. Payne, Chief Elec., Carrie Fces., Carnegie Steel Co., Rankin, Pa.
J. A. Northwood, Supt. Personnel, Bethlehem Steel Co., Sparrows Point, Md.

LUBRICATION ENGINEERING DIVISION

EXECUTIVE COMMITTEE

Chairman, C. C. Pecu, Lubr. Engr., Bethlehem Steel Co., Lackawanna, N. Y.
Secretary, T. B. Little, Association of Iron & Steel Electrical Engineers, Pittsburgh, Pa.
A. D. Adams, Asst. Supt., Spang Chalfant Co., Inc., Ambridge, Pa.
D. B. Geeseman, Gen. Mgr., Standard Tin Plate Co., Canonsburg, Pa.
J. A. Clauss, Chief Engr., Great Lakes Steel Corp., Ecorse, Mich.
Vic Chartner, Chief Engr., Pittsburgh Steel Co., Monessen, Pa
J. D. Kelvie, Chief Elec., Republic Steel Corp., Massillon, Ohio.
J. H. Krehl, Supt. Mech. Dept., Youngstown Sheet & Tube Co., Youngstown, Ohio.
C. A. Bollinger, M. M., American Sheet & Tin Plate Co., New Castle, Pa.
F. J. Binckes, Asst. Chief Engr., Inland Steel Co., Indiana Harbor, Ind.
C. A. Baumann, Chief Mech. Engr., Carnegie Steel Co., Clairton, Pa.
J. C. Green, Asst. Engr., Pittsburgh Crucible Steel Co., Midland, Pa.
F. L. Gray, Lubr. Engr., Illinois Steel Co., Gary, Ind.
C. W. Phillips, Gen. M. M., Republic Steel Corp., Warren, Ohio.
F. C. Hallmark, Gen. M. M., Wheeling Steel Corp., Steubenville, Ohio.
H. G. Gibson, Chief Engr., McKeesport Tin Plate Co., McKeesport, Pa.
C. J. Duby, Chief Engr., Republic Steel Corp., Warren, Ohio.
J. G. Gage, Gen. Supt., American Rolling Mill Co., Butler, Pa.
Carl S. Walrab, M. M., Calumet Steel Co., Chicago Heights, Ill.

L. A. Wynd, M. M., Keystone Steel & Wire Co., Peoria, Ill.
J. M. Faris, Asst. to Vice Pres., Youngstown Sheet & Tube Co., Youngstown, Ohio.
E. C. Kirkpatrick, Mech. Engr., Steel Company of Canada, Ltd., Montreal, Quebec, Canada.
L. F. Coffin, Supt. Mech. Dept., Bethlehem Steel Co., Sparrows Point, Md.
S. N. Roberts, Mech. and Elec. Supt., Atlantic Steel Co., Atlanta, Ga.
R. C. Mohler, Distr. Engr., American Steel & Wire Co., Pittsburgh, Pa.
E. J. Harrington, Lubr. Engr., Tata Iron & Steel Co., Ltd., Jamshedpur, India.
Howard M. Miner, M. M., Follansbee Bros. Co., Toronto, Ohio.
H. F. Martin, M. M., Jones & Laughlin Steel Corp., Aliquippa, Pa.
John F. Pelly, Bethlehem Steel Co., Bethlehem, Pa.
Samuel Roberts, Lubr. Engr., Carnegie Steel Co., Homestead Works, Munhall, Pa.
John M. Husher, Gen. M. M., Pittsburgh Steel Co., Monessen, Pa.
H. J. Mercer, Lubr. Engr., Youngstown Sheet & Tube Co., Campbell, Ohio.

LUBRICANT AND DEVICE DEVELOPMENT COMMITTEE

Chairman, C. C. Pecu, Lubrication Engineer, Bethlehem Steel Co., Lackawanna, N. Y.
Secretary, T. B. Little, Association of Iron & Steel Electrical Engineers, Pittsburgh, Pa.
H. G. Mullen, Grease Sales Supv., Tidewater Oil Sales Corporation, New York, N. Y.
M. Reswick, Lubr. Engr., Standard Oil Company of New Jersey, New York, N. Y.
W. H. Oldacre, Director of Research and Engineering, D. A. Stuart & Co., Ltd., Chicago, Ill.
E. W. Beardsley, Sec'y and Gen. Mgr., The Ohio Grease Company, Loudonville, Ohio.
J. R. Michael, Treas. and Gen. Mgr., Hulburt Oil & Grease Company, Philadelphia, Pa.
K. A. Newman, Lubr. Sales Engr., E. F. Houghton & Company, Philadelphia, Pa.
J. H. Garlough, Lubr. Engr., Valvoline Oil Company, New York, N. Y.
C. E. Sperry, Service Engr., Detroit Lubricator Company, New York, N. Y.
Joseph F. Hall, Asst. Ch. Engr., The Ironsides Company, Columbus, Ohio.
Wm. R. Maize, Sales Engr., Sinclair Refining Co., Cleveland, Ohio.
H. E. Pryor, Sales Engr., Banfield Oil & Grease Co., Etna, Pa.
A. F. Brewer, Mech. Engr., The Texas Company, New York, N. Y.
Foster Holmes, Sales Mgr., Lincoln Engineering Co., St. Louis, Mo.
Joseph F. King, Sales Mgr., Waverly Oil Works Company, Pittsburgh, Pa.
R. G. Schenck, Sales Engr., Fiske Brothers Refining Co., Cleveland, Ohio.
G. W. Miller, President, American Lubricants Co., Buffalo, N. Y.
H. J. Turner, Distr. Mgr., Sharples Specialty Co., Pittsburgh, Pa.
Philip King, Engineer, Keystone Lubricating Co., Philadelphia, Pa.
James Graham, Lubr. Engr., Universal Lubricating Co., Cleveland, Ohio.
J. G. McCaw, Ass't to V. P., The Freedom Oil Works Co., Freedom, Pa.
W. E. Smith, Lubr. Engr., National Refining Co., Cleveland, Ohio.
E. S. Glauch, Mech. Engr., Jos. Dixon Crucible Co., Jersey City, N. J.
R. M. Gordon, President, R. M. Gordon & Company, Pittsburgh, Pa.
F. G. Grassle, Sec'y, Hills-McCanna Company, Chicago, Ill.
R. F. Crego, Sales Engr., Universal Gear Corp., Chicago, Ill.
A. J. Jennings, V. P., Farval Corp., Cleveland, Ohio.
J. G. Griffith, President, J. G. Griffith Company, Pittsburgh, Pa.
Frank B. Godard, Div. Sales Mgr., U. S. Graphite Company, Pittsburgh, Pa.
W. D. Hodson, President, Hodson Corporation, Chicago, Ill.
T. J. Kauffeld, Div. Sales Mgr., DeLaval Separator Company, Pittsburgh, Pa.
V. J. Nolan, Distr. Sales Mgr., National Carbon Company, Inc., Pittsburgh, Pa.
S. A. Newman, Chief Lubrication Engr., Gulf Refining Co., Pittsburgh, Pa.
F. E. Jacques, Lubr. and Sales Engr., Sun Oil Company, Youngstown, Ohio.
Geo. P. Dempler, President, Geo. P. Dempler Company, Pittsburgh, Pa.
N. M. Kiener, Lubr. Engr., New York & New Jersey Lubricant Co., Akron, Ohio.
H. H. Gillett, Jr., Engr., Standard Oil Company of Ohio, Cleveland, Ohio.
H. F. Hackedorn, Sales Mgr., Lubrication Products Co., Cleveland Ohio.

ROLLING MILL EQUIPMENT COMMITTEE

Chairman, F. C. Hallmark, Genl. M. M., Wheeling Steel Corporation, Steubenville, Ohio.
H. S. Lamb, Vice Pres., Cold Metal Process Company, Youngstown, Ohio.
L. W. Nash, Gen. Mgr., E. W. Bliss Co., Salem, Ohio.
R. J. Wean, Pres., Wean Engineering Co., Warren, Ohio.
D. A. Keating, Chief Engr., American Tube & Stamping Co., Stanley Works, Bridgeport, Conn.
J. H. Van Campen, Engr., Republic Steel Corp., Youngstown, Ohio.
C. E. Bedell, Elec. Engr., Mesta Machine Co., Pittsburgh, Pa.
E. Peterson, Chief Engr., Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Myles Morgan, Engr., Morgan Construction Co., Worcester, Mass.
John B. Morgan, Elec. & Mech. Engr., Wm. B. Pollock Co., Youngstown, Ohio.
A. T. Davis, Sales Mgr., Morgan Engineering Company, Alliance, Ohio.
K. Feller, Sales Mgr., Schloemann Engineering Co., Pittsburgh, Pa.
Leonard Larson, Chief Engr., Republic Steel Corp., Massillon Ohio.
J. C. Murray, Asst. Gen. Supt., Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Frank Smith, Engr., Otis Elevator Company, Pittsburgh, Pa.
H. W. Smith, Chief Engr., Aetna-Standard Engineering Company, Ellwood City, Pa.
J. P. Biggert, Engr. Tool Steel Gear & Pinion Co., Pittsburgh, Pa.
R. H Ellis, Elec. Engr., United Engineering & Foundry Co., Pittsburgh, Pa.
L. R. Botsai, Engr., R. D. Nuttall Wks., Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.
Edgar E. Brosius, Pres., Edgar E. Brosius Inc., Sharpsburgh, Pa.
Walter de Fries, Special Engr., Pittsburgh Steel Foundry Co., Glassport, Pa.
G. Fast, Pres., Gustave Fast Engr. Corp., Annapolis, Md.
J. E. Holveck, V. P., Aldrich Pump Co., Pittsburgh, Pa.
H. L. Horne, Elec. Engr., S. Diescher & Son, Pittsburgh, Pa.
M. T. Maguire, Mgr. Coupling Department, Bartlett Hayward Co., Baltimore, Md.
Austin Kuhns, Engr., Farrel-Birmingham Company, Inc., Buffalo, N. Y.
H. W. Morgan, Chief Engr., Poole Foundry & Machine Co., Baltimore, Md.
Lloyd Jones, Vice Pres., Continental Roll & Steel Foundry Co., Pittsburgh, Pa.
F. H. Moyer, Vice President, Mackintosh-Hemphill Co., Pittsburgh, Pa.
F. A. Beatty, Chief Engr., Lewis Foundry & Machine Co., Pittsburgh, Pa.
K. H. McLaurin, Chief Engr., Carnegie Steel Co., Duquesne, Pa.

ITEMS OF INTEREST

PERSONNEL CHANGES

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Dr. Charles H. Herty, Jr., has been appointed research engineer in the development and research department of Bethlehem Steel Co., Bethlehem, Pa. Well-known in steelmaking circles for his extensive studies and reports on open hearth operation, Dr. Herty formerly was director of research for the Metallurgical Advisory Board of Carnegie Institute of Technology, Pittsburgh. He graduated from the University of North Carolina in 1918 and in 1921 was awarded his doctor of science degree from Massachusetts Institute of Technology.

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Thomas Woods, assistant to the president of Carnegie Steel Co., has resigned effective October 1. In the employ of Carnegie Steel and its predecessors for the past 53 years, he retires through the operation of the United States Steel Corporation's retirement plan.

Mr. Woods began his Carnegie career in 1881 with Carnegie Bros. & Co., Ltd. In 1900 he was appointed assistant general agent for Carnegie, Phipps & Co., and in 1924, special agent for Carnegie Steel Co. In January, 1927, he was appointed assistant to the president, and in October, 1930, director of the company. Since 1924 he has been in charge of the disposal of coke oven by-products, blast furnace products and the purchase of scrap.

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Carl W. Meyers, roll engineer, Republic Steel Corporation, has been made assistant manager of the Canton and Massillon, Ohio, district, with headquarters at Canton. Prior to his association with Republic Steel Corporation, he had been superintendent of the Carnegie Steel Company's McDonald works.

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Alexander C. Brown, formerly president of the Industrial Brownhoist Corp., Bay City, Mich., has been elected first vice president of the Cleveland-Cliffs Iron Co., Cleveland. He has resigned from the Bay City organization and will assume his new duties at once.

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John C. Bane, Jr., has been elected secretary of Pittsburgh Forgings Co., Inc., Coraopolis, Pa. He is also director of the company.

John E. McKelvey has been elected a director of the company, succeeding C. E. Rafter, who has retired from the board but continues as treasurer.

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Harold Smith has been elected vice president of the Westinghouse Electric International Company, according to a recent announcement by G. H. Bucher, president of that organization.

Mr. Smith joined the personnel of Westinghouse in 1919 as a member of the legal department of the Westinghouse Electric and Manufacturing Company. In 1926 he was appointed general solicitor and in 1929, vice president.

Mr. Smith's new duties will be in addition to those of his position as vice president of the Westinghouse Electric and Manufacturing Company. His headquarters are at 30 Rockefeller Plaza, New York City.

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The Norma-Hoffmann Bearings Corporation of Stamford, Conn., manufacturers of precision ball and roller bearings, announce the appointment of E. W. Lawrence as its Southern representative. He has for the past eleven years been connected with the New York sales office.

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Electro Dynamic Works, division of Electric Boat Company, Bayonne, N. J., manufacturers of electric motors and generators, announces the appointment of N. M. Mintz as representative with offices at Fortieth street and Calumet avenue, Chicago, Ill.

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According to a recent announcement by F. A. Merrick, president of the Westinghouse Electric Supply Company, Bonnell W. Clark has been appointed vice president and general manager of that company and both H. N. Gansman and R. J. Holtermann, vice presidents.

Mr. Clark joined the Westinghouse Commercial Investment Company as a special agent in 1925, later becoming assistant to the vice president, and in 1927 receiving the appointment of general manager of that company. When the company name was changed to Westinghouse Electric Supply Company, Mr. Clark retained his position as general manager. Mr. Clark's headquarters are located at 30 Rockefeller Plaza, New York City.

Mr. Gansman, upon graduation from the University of Pennsylvania with a degree in mechanical engineering, became an apprentice with the Westinghouse Electric and Manufacturing Company at East Pittsburgh. He has been with the Westinghouse Company during his entire business career and, in 1920, when Westinghouse decided to build up a chain of distributing, he was given the management of the first institution they acquired. In 1931 he came to New York to become general sales manager of the Westinghouse Electric Supply Company.

Mr. Gansman's headquarters are at 150 Varick street, New York City.

R. J. Holtermann, whose headquarters are in the San Francisco offices of the Westinghouse Electric Supply Company, has spent his entire business career in the electrical supply business. He started with the Holabird and Reynolds Electrical Supply Company in San Francisco. This concern later became part of the Fobes Supply Company which, in 1923, was acquired by Westinghouse interests. In 1932 Mr. Holtermann was made district manager for the Westinghouse Electric Supply Company's entire operations west of the Rocky Mountains. He now follows this work up with added responsibility, in the official capacity of vice president.

ASSOCIATION NOTES
COMING MEETINGS AND PAPERS

Chicago Section

C. J. Smith, Chairman A. J. Whitcomb, Secretary
Electric Association, 20 North Wacker Drive
Dinner 6:30 P. M.

November 7, 1934

"Hoover Dam—General Construction of same and the Fabrication and Welding of the Penstock Piping," by W. E. East, Babcock & Wilcox Company.

Philadelphia Section

L. F. Coffin, Chairman L. O. Morrow, Secretary
Engineers' Club, 1317 Spruce Street
Dinner 6:00 P. M. Meeting 7:00 P. M.

November 3, 1934

"The Modern Electric Overhead Traveling Crane," by R. J. Harry, Sales Manager, Alliance Machine Company, Alliance, Ohio.

Discussion

"Crane Wheels," John C. Reed, Electrical Engineer, Bethlehem Steel Co., Steelton, Pa.

"Safety Features," R. F. Gale, Plant Engineer, The Midvale Co., Philadelphia, Pa.

"Crane Gearing," George Pfeffer, Electrical Supt., Florence Pipe Foundry & Machine Company, Florence, N. J.

"Crane Control," Harry H. Angel, Control Specialist, Bethlehem Steel Company, Sparrows Point, Md.

"Anti-Friction Bearings for Cranes," A. J. Standing, Electrical Supt., Bethlehem Steel Company, Bethlehem, Pa.

Cleveland Section

C. C. Wales, Chairman W. W. Spanagel, Secretary
Cleveland Engineering Society Rooms
Dinner 6:15 P. M. Meeting 8:00 P. M.

October 26, 1934

"Selection and Application of Cable," by F. V. Calvert, District Cable Specialist, General Electric Company.

Pittsburgh Section

H. G. R. Bennett, Chairman C. H. Hunt, Secretary
Cardinal Room, William Penn Hotel
Friday Afternoon and Evening
2:00 P. M. 7:00 P. M.
Dinner 6:00 P. M.

November 2, 1934

"General Purpose Motor and Magnetic Control Symposium in Connection with Sheet and Tin Mills, Pipe Mills, Strip Mills, Wire Mills and Machine Tools," by Motor Manufacturers and Control Manufacturers.

Each Manufacturer will present one particularly interesting application or new development for Sheet and Tin Mills, Strip Mills, Wire Mills, Pipe Mills and Machine Tools.

Motor Discussion by Westinghouse Electric & Mfg. Co., General Electric Co., Reliance Electric & Engineering Co., Crocker Wheeler Electric Mfg. Co., and Allis Chalmers Mfg. Co.

Magnetic Control Discussion by Cutler Hammer, Inc., Clark Controller Co., and Electric Controller & Mfg. Co.

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OBITUARIES

A. B. Holcomb, Pittsburgh representative of the D. B. Flower Mfg. Co., died at his home October 9th. Mr. Holcomb was born in Connecticut and educated at Hartford High School and the Polytechnic Institute, Worcester, Mass. He was a member of the faculty of Cornell University and later at Carnegie Institute of Technology. Mr. Holcomb was a associate member of the A. I. & S. E. E. for many years. His host of friends in the Iron and Steel Industry together with the members of the Association extend their condolences to the family and associates of this capable and widely known engineer.

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C. W. Parkhurst, Consulting Engineer, Berwind-White Coal Mining Company, Philadelphia, and a Past President of the Association of Iron and Steel Electrical Engineers died on September 30. Mr. Parkhurst was an active member of the Philadelphia Section and had been a member of the Association since 1908.

C. W. PARKHURST

In 1893, Mr. Parkhurst graduated from Lehigh University as an Electrical Engineer. From 1893 to 1896 he was employed in the Electrical Department of Cramp's Ship Yard. One year and a half from the time he entered their employ as a wireman's helper he was made Assistant Superintendent. He had charge of electrical installations of "Columbia," "Minneapolis," "Brooklyn," "Indiana," Massachusetts," "Iowa," "St. Louis" and "St. Paul."

In 1897 he had charge of electrical equipment at 23rd St. Ferry, New York, for the Pennsylvania Railroad. During 1898 he was in the Chief Engineer's office of the Metropolitan Street Railway, New York, having charge of trackwork design. In 1899 he was in charge of electrical installation of the "Wisconsin," and "Chitose" at Union Iron Works, San Francisco. He was then employed by the Siemens & Halske Electric Company of America, Chicago, as Assistant Chief Engineer, having charge of design.

In 1900 he became associated with the Cambria Steel Company as Superintendent of Electrical Department. For 16 years he was in charge of engineering, installation, operation and maintenance of all electrical equipment. Since 1917 he had been Consulting Engineer for the Berwind-White Coal Mining Company, Philadelphia, Pa. From 1917 to 1922 he was also Consulting Engineer for Perin & Marshall, New York, on work in India and Russia.

Mr. Parkhurst was a member of the A. I. & S. E. E. for 26 years. He served on many national committees and was President of the Society in the year 1913. He was very active in Association activities and contributed many valuable discussions to the Proceedings of the Association.

The A. I. & S. E. E. wishes to take this opportunity of expressing its deepest sympathy to the family, friends and associates of this nationally known engineer.